

Mitigation and Monitoring Plan

Adobe Gulch Grassland Restoration Site
San Mateo County, California

October, 2010

FINAL

Prepared for:

San Francisco Public Utilities Commission
1155 Market Street
San Francisco, CA 94103

Agreement No. CS-883D

Prepared by:



633 Third Street
Eureka, CA 95501

**San Francisco Public Utilities Commission
Mitigation and Monitoring Plan for the
Adobe Gulch Grassland Restoration Project**

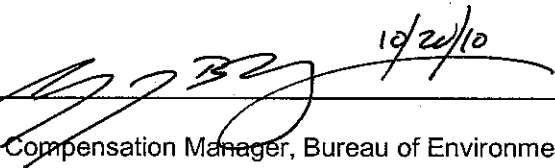
SFPUC Water Enterprise, Natural Resources and Lands Management staff, are aware of the following Mitigation and Monitoring Plan (Plan) and agree to oversee its implementation as described, including monitoring and reporting, unless otherwise agreed to by the appropriate regulatory resource agencies. Implementation funding, through the contractor's "warranty period", will be provided via the individual Water System Improvement Program project (WSIP) budgets. The SFPUC Water Enterprise, Natural Resources and Lands Management Division, will fund post-warranty implementation to meet site restoration requirements.



Tim Ramirez
Manager, Natural Resources & Lands Management Division

10/20/10

Date



Greg Lyman
WSIP Habitat Compensation Manager, Bureau of Environmental
Management

10/20/10

Date

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1.0 INTRODUCTION

1.1 Background

This Mitigation and Monitoring Plan (MMP) describes part of the Habitat Reserve Program (HRP) the San Francisco Public Utilities Commission (SFPUC) will implement to create and enhance habitat within the Peninsula watershed, located in San Mateo County, California (Figure 1). The HRP focuses on developing consolidated compensation for the series of projects included in the Water System Improvement Program (WSIP). The Adobe Gulch Grassland Restoration project proposes to rehabilitate 49.7 acres of grassland, enhance 0.23 acres of seasonal wetland, establish 0.61 acres of seasonal wetlands, enhance and establish 9.2 acres of coast live oak woodland, re-establish 0.5 acre/1,135 linear feet of arroyo willow riparian forest, and establish 0.4 acres/1,400 linear feet of coast live oak riparian forest. The total acreage of habitats preserved, enhanced, restored, and created for this plan totals 60.53 acres. The Draft MMP follows the SFPUC Guidance for Consultants Preparing Mitigation and Monitoring Plans (April 2009 Review Draft) prepared by May and Associates (2009) and, more generally, the mitigation and monitoring guidance issued by the U.S. Army Corps of Engineers (USACE, 2004), but has been modified and broadened to include site specific factors and upland habitat.

Hydrological observations are ongoing through the end of May 2010, to inform design of riparian and seasonal wetland areas. The final MMP was completed in September 2010 and includes hydrological interpretation, a grading plan, and other more detailed design information (Appendix A-E).

1.2 Responsible Parties

The applicant is the San Francisco Public Utilities Commission, 1145 Market Street, San Francisco CA, 94103. The contact person is Greg Lyman, (415) 554-1601.

This Mitigation and Monitoring Plan was prepared by Winzler & Kelly, 633 Third Street, Eureka CA, 95501. The lead author is Ken Mierzwa. The contact person is Misha Schwarz, (707) 443-8326.

2.0 PROJECTS REQUIRING MITIGATION

2.1 Location

The habitats preserved, enhanced, restored, and created would be used to compensate for impacts from SFPUC projects. This MMP may be referenced in permit applications for SFPUC Water System Improvement Program (WSIP) projects and projects not included in the program. SFPUC projects that may reference habitat improvements at Adobe Gulch Grasslands Restoration project include, but are not limited to Crystal Springs Pipeline No. 2 Replacement, Crystal Springs San Andreas Transmission Upgrade, and Lower Crystal Springs Dam Improvements. Table 1 summarizes the habitat impacts of WSIP projects for which the Adobe Gulch Grasslands site will serve as compensation

Table 1 - Water System Improvement Program Projects and Adobe Gulch Grasslands Restoration Project Benefit

Adobe Gulch Grassland	Seasonal Wetland		Oak Riparian		Arroyo Willow Riparian		Oak Woodland		Coast Live Oak Woodland		Coastal Terrace Prairie	Northern Coyote Brush Scrub
	Enhanced	Established	Established		Established		Enhanced	Establish ed	Enhanced	Established	Established	Enhanced
	ACRES	ACRES	ACRES	LF	ACRES	LF	ACRES	ACRES	ACRES	ACRES	ACRES	ACRES
HABITAT AVAILABLE	0.20	0.51	0.40	1,150.00	0.50	1,135.00	7.70	2.20	9.10	1.50	47.00	3.00
Crystal Springs Pipeline No. 2 Replacement				60.00						0.50		
Crystal Springs San Andreas Transmission Upgrade			0.41	770.00				2.20	0.50		13.20	
Lower Crystal Springs Dam Improvements		0.51			0.50	1,135.00					33.80	
Unassigned	0.20	0.00	0.00	0.00	0.00	0.00	0.00		8.60	1.00	0.00	

3.0 PROPOSED MITIGATION SITE

3.1 Location

The Adobe Gulch Grasslands Restoration project site is located west of Interstate Highway 280 and Upper Crystal Springs Reservoir and south of SR 92, within the Crystal Springs Reservoir watershed, which includes most of the SFPUC Peninsula holdings (Figure 1).

3.2 Selection Process and Ownership Status

The proposed project site was chosen because it includes examples of plant community types targeted for mitigation, as well as degraded areas with opportunities to create or expand natural community types. Habitat enhancement opportunities, including invasive species removal or control, are available within the boundaries. The site also could potentially support populations of targeted special-status species, including the California red-legged frog, San Francisco garter snake, and others, which are likely to benefit from habitat improvements. The proposed mitigation site is owned by SFPUC.

3.3 Existing Conditions

Existing conditions at the Adobe Gulch Grasslands site are described below.

3.3.1 Jurisdictional Areas

Most of the site is rolling and well-drained upland. Seasonal wetland SW43.1 (0.202 acres/8,817 square feet, data point 43.2) exists in the south central portion of the site immediately to the north of the road that will be converted to riparian habitat. A map of jurisdictional wetland SW43.1 is included as Figure 2 (ESA, 2009). Wetland SW43.1 will be managed to remove non-native vegetation as part of the overall site enhancement; the wetland will then be enhanced with native wetland species per the planting plan. Seasonal wetland SW43.2 (approximately 0.0171 acres/748.46 square feet, data point 43.3) exists in a swale just outside of the site in the northwest vicinity of the project boundary. Seasonal wetland SW43.3 (3.01 acres/130,906 square feet, data points 43.5) is present just beyond the eastern edge of the site boundary. Neither wetland SW43.3 and SW43.2 will not be altered or managed as part of this project.

3.3.2 Functions and Values

The proposed project is within the SFPUC's Peninsula Watershed, which includes Upper Crystal Springs Reservoir, Lower Crystal Springs Reservoir, San Andreas Reservoir, several streams which flow into the reservoirs, and most of SFPUC's holdings in San Mateo County (Figure 1). The SFPUC's mission for managing the Peninsula Watershed is to provide the best environment for the production, collection, and storage of the highest quality water for the City and County of San Francisco and other wholesale customers. The SFPUC seeks to accomplish this by developing, implementing, and monitoring a resource management program which addresses all watershed activities. The watershed management program applies best management practices for the protection of water and natural resources and their conservation, enhancement, restoration, and maintenance while balancing financial costs and benefits (SFPUC 2008). Thus, as a part of

the SFPUC-managed Peninsula Watershed, water quality protection is a primary function of the Project Area.

Other functions of the proposed project site include habitat for several endangered, threatened or sensitive species. The Adobe Gulch Grasslands site is in proximity to known occurrences of the federally threatened California red-legged frog (*Rana draytonii*), two federally endangered butterflies, Bay checkerspot butterfly, (*Euphydryas editha bayensis*) and Mission Blue Butterfly, (*Icaricia icarioides missionensis*) and the federally endangered and state fully protected San Francisco garter snake (*Thamnophis sirtalis tetrataenia*). Three state species of special concern, the western pond turtle (*Actinemys marmorata*), saltmarsh common yellowthroat (*Geothlypis trichas sinuosa*) and San Francisco dusky-footed woodrat (*Neotoma fuscipes annectans*), are known from the Peninsula Region. The former has been observed in shallow margins of Upper Crystal Springs Reservoir just southeast of the site, and a nest of the latter has been observed within the site boundary.

3.3.3 Topography and Hydrology

The project site is within the San Mateo Creek watershed. Named tributaries to San Mateo Creek are San Andreas Creek to the northwest and Laguna Creek to the southeast. A number of small, unnamed watercourses flowing from the ridges of the Santa Cruz Mountains, drain eastward. San Mateo Creek is impounded by Lower Crystal Springs Dam, forming Upper and Lower Crystal Springs Reservoirs, which extend for more than six miles along the San Andreas Fault Zone. Originally formed by separate impoundments, the two reservoirs are currently connected by culverts, allowing free exchange between them. About two miles to the northwest of Lower Crystal Springs Dam is San Andreas Reservoir, an impoundment on San Andreas Creek. These reservoirs are connected by pipelines; little or no surface flow passes down San Andreas Creek to Lower Crystal Springs Reservoir. Smaller impoundments are also present in the watershed, such as Mud Dam 1 and 2. A hydrology basemap is shown in Figure 4.

The Adobe Gulch Grasslands site is characterized by rolling terrain, with a low swale trending northwest to southeast through the center of the site. Elevations within the 60.4-acre site range from less than 300 feet on the east to just over 450 feet on the west. Existing topography is shown in Figure 3.

Hydrological data collection continued through the end of May 2010, and results have been incorporated into the final MMP

3.3.4 Geology and Soils

Location

The project site is located within the Coast Ranges Geomorphic Province of California. It is situated on the northern and eastern foothills of the Santa Cruz Mountains, east of Montara Mountain within the San Andreas Fault Zone (SAFZ). The active San Andreas Fault trace bisects the Upper and Lower Crystal Springs Reservoirs in a northwesterly direction resulting in northwest-southeast orientated ridges and linear valleys. Some prominent physical features west of the San Andreas Fault Zone include Fifield Ridge, Sawyer Ridge, Cahill Ridge, Sweeney Ridge, and Montara Mountain; east of the San Andreas Fault Zone are Buri Buri Ridge and Pulgas Ridge.

Geology

Bedrock within the project region consists of greenstone, sandstone, serpentinite, mélangé and chert. Most noteworthy for biological resources are areas of serpentines (secondary minerals, derived by alteration of magnesium-rich silicate minerals). An extensive area of serpentine extends for more than 10 miles along the eastern side of San Andreas Reservoir, San Andreas Creek and Upper and Lower Crystal Springs Reservoir and extends for approximately 4 miles on the west side of San Andreas Creek from San Andreas Reservoir to Sherwood Point near the confluence of upper San Mateo Creek into Lower Crystal Springs Reservoir. To the west of the San Andreas Fault Zone and Crystal Springs Reservoir is mostly comprised of greywacke, sandstone, shale, conglomerate, greenstone, and granitic rocks associated with Montara Mountain. The Adobe Gulch project site is bound on the east by the Pilarcitos Fault and west by the SAFZ, along the edge of Crystal Springs Reservoir. The project area has been mapped as the Santa Clara Formation (Qts) [upper Pliocene and lower Pleistocene age] which is composed of conglomerate, sandstone, and mudstone in irregular and lenticular beds. The conglomerate portion consists mainly of subangular to subrounded cobbles in a sandy matrix but locally includes pebbles and boulders. Cobbles and pebbles are mainly chert, greenstone, and greywacke with some schist, serpentine, and limestone.

Soils

The Soil Survey for Adobe Gulch maps the majority of the site as “Fagan loam, 15 to 50 percent slope” (Soil Survey Staff, 2009). A thin strip of Candlestick variant loam 2 to 15 percent slope is mapped along the road to the south of the project site, and Los Gatos loam 30 to 75 percent slope is mapped along Old Cañada Road to the west of the site. The Fagan Series consists of shallow to deep, gently rolling to steep, well-drained upland soils. Although Fagan loams are derived from sandstone, they appear to contain some of the chemical attributes of soils derived from serpentinite, as extensive populations of serpentine-associated plants can be found on Fagan soils. The Fagan loam soil series is described as well drained, with approximately 40 to 60 inches of soil prior to paralithic contact, nonsaline, with moderate available water capacity (about 7.1 inches). A typical profile would have loam from 0-5 inches, clay loam from 5 to 26 inches, and clay from 26 to 43 inches depth. The land capability for nonirrigated crops is 6e which indicates severe limitations, generally unsuitable for cultivation and restricting use to mainly pasture, rangeland, forestland, or wildlife habitat. The Storie Index is Grade Three (Fair). Fagan soils are moderately suited for hand planting due to stickiness and high plasticity. The erosion hazard is moderate with a slope erodibility numeric value of 0.50 from off road/off-trail areas after disturbance activities that exposed the soil surface, and is rated severe with a slope erodibility value of 0.95 for soil loss from unsurfaced road/trails. The numeric value indicates gradations between the point at which a soil feature has the greatest negative impact on the specified aspect of forestland management (1.00) and the point at which the soil feature is not a limitation (0.00). The Fagan soil is rated Severe (due to low soil strength) for the hazard of surface rutting through the operation of forestland equipment. Soil displacement and puddling (soil deformation and compaction) may occur simultaneously with rutting.

Soil Sampling Soil sampling at shallow depths was conducted by installing 2-inch-diameter hand augured boreholes to the maximum depth possible (until refusal at bedrock or gravels). Soil samples were collected and logged to document observed soil conditions at the site. Surface and

subsurface soil samples were collected at all sites for analysis and fertility testing. These samples were submitted to a laboratory for chemical testing.

Three soil pits (SP-1a, SP-1b, and SP-1c) were installed within the proposed shrub removal/grassland restoration area to total depths of 2.0 feet below ground surface (bgs), 2.0 feet bgs, and 1.0 foot bgs, respectively (Figure 5). Surface soil subsamples were collected at each soil pit from 0 to 6-inches depth. Subsurface samples were collected from the total depth of the soil auger hole at approximately 18-24-inches depth. Subsurface samples, correlated by depth, were composited into one single sample for laboratory analysis. In the shrub removal/grassland restoration area, the soils are characterized as loam at the surface underlain by sandy clay loam and a dense clay layer in the subsurface at around 2 feet depth.

An additional soil pit SP-2 was investigated from the proposed riparian restoration area, from the face/profile of an eroded ditch. The Adobe Gulch riparian area soils evaluated on the face/profile are described as loam at the surface underlain by clay loam from 1 to 2 feet bgs. Soil erodability is the main concern for this site due to the proposed installation of a riparian flow channel/meander with adjacent native plantings, and this will be addressed in design. The soil was characterized but no samples were collected from this location as soil fertility for growing riparian vegetation is not considered a concern at this site.

Soil fertility is not typically a problem in riparian areas which have continuous interactions between the riparian, aquatic, and upland terrestrial ecotone through exchanges of energy, nutrients, and species. Due to the complex interface of mesic and xeric conditions, riparian ecosystems are uniquely characterized by the combination of high species diversity, high species density, and high productivity. (Johnson and McCormick, 1979).

Therefore, soil fertility is not a concern for establishing riparian vegetation on this site because the system has hydrologic connectivity to surface and groundwater and will allow for continued nutrient cycling. These wetlands will be fed by approximately 1 acre foot of water volume. Nutrients in riparian systems are in part supplied by organic material and water delivered from upstream and deposited during overbank flooding events. The fluctuating water levels of this ecotype provide various amounts of water moisture. The flooding acts like a ventilation system for the soil and roots where gas exchange is released at a higher rate (USDA, 2007).

Riparian vegetation is adapted to the fluctuating water levels and exchange of nutrient rich organic material being deposited from upstream during a high water event. These nutrient rich sediments can hold moisture for long periods in the soil allowing for a variety of plant life on this habitat type. The nutrients that are easier to dissolve are utilized by deep rooted vegetation as the nutrients are leached downward through the soil horizon. Grasses tend to favor nutrients closer to the surface such as, nitrogen, magnesium, phosphorous, and calcium. In the fall, as the plants die and the leaf litter is accumulated and decomposed continuing the nutrient cycling process (USDA, 2007). Ensuring soil moisture for the appropriate temporal and spatial constraints is the biggest concern for establishing riparian vegetation.

Soil pit SP-3 was installed in a proposed wetland area at the eastern end of Adobe Gulch Grasslands, near the road intersection with the auxiliary boat ramp road. SP-3 had loam at the

surface underlain by a dense clay loam from 1 to 1.5 feet and that had signs of possible perched water due to faint presence of redoximorphic features (2%). From 2.0 feet to total depth of 3.5 feet bgs the soil texture became coarser to a sandy clay loam with no reduced matrix or redoximorphic features apparent from 2 to 3 feet bgs (see boring log, Appendix C), indicating that groundwater held at the site would be in the surface layers. Wetland mitigation design for this location should either avoid digging deeper than the clay loam as the underlying coarser sandy clay loam could allow ponding water to percolate out of the wetland mitigation system, or stockpile and reuse the clay loam in the completed excavation to create a hydraulic barrier to percolation. A subsurface soil sample was collected from 18-24 inches bgs, results are found in Appendix C.

3.3.5 Vegetation

The Adobe Gulch Grasslands site is dominated by interspersed scrub and grassland, with inclusions of oak woodland and wetland. Existing vegetation communities are shown in Figure 6.

ESA (2009) mapped the grassland as Coastal Terrace Prairie, and suggested that a local fogbelt may contribute to microclimate conditions similar to those closer to the coast. Remnant native bunchgrass openings are scattered throughout the site; these tend to be small, but range from moderate to good quality with about 50 percent native cover. Dominant and subdominant species include foothill needlegrass (*Nasella lepida*), California oatgrass, (*Danthonia californica*), blue wildrye (*Elymus glaucus*), blue-eyed grass (*Sisyrinchium montanum*), Douglas iris (*Iris douglasiana*), Indian paintbrush (*Castilleja*), yarrow (*Achillea millefolium*), foothill sedge (*Carex tumulicola*), spreading rush (*Juncus patens*), velvet grass (*Holcus lanatus*), purple needlegrass (*Nassella pulchra*), and plantain (*Plantago major*).

The scrub community is dominated by coyote brush. Coast live oak woodland is present in the southern part of the site, with scattered clusters or individual oaks scattered through the western and central parts of the site. A seasonal wetland (#43.1) borders the oak woodland at the southern edge.

The extreme western edge of the site includes a stand of Monterey cypress (*Cupressus macrocarpa*) and Monterey pine (*Pinus radiata*), which occur naturally elsewhere in California but are not native to the project area. Scattered Monterey cypress and Monterey pine are present in various locations over the western half of the site; many of these at present are very small. A few oaks have been observed within the existing Monterey cypress/pine woodland. Locations of the larger trees and clusters are shown in Figure 7.

3.3.6 Present and Historical Uses of Mitigation Area

The project site is presently maintained as open space within a larger area maintained by SFPUC as part of the SFPUC's Peninsula water supply watershed. Small roads or trails pass close to the site, including a gravel-surfaced road on the west and an unimproved road on the south. Prior to acquisition by the City of San Francisco parts of the project site may have been used for grazing, light agriculture, or other relatively low-intensity purposes. The remains of an old home site are present near the southern boundary.

3.3.7 Present and Proposed Uses of Adjacent Areas

Adjacent areas are managed as open space.

4.0 CHARACTERISTICS OF REFERENCE SITES

4.1 Location

Reference sites are located within SFPUC Peninsula Watershed holdings, and are shown on Figure 8. Summary descriptions are provided below, and more detailed information is included in Appendix E. Reconnaissance surveys were conducted on December 12, 2008 by NRM Environmental, with more detailed sampling by Winzler & Kelly on April 7-9 and May 6-7, 2009.

4.2 Selection Process

Potential reference sites for each major community type to be enhanced, restored, or created were initially identified by SFPUC in consultation with NRM and Winzler & Kelly. NRM then conducted rainy season reconnaissance visits of each site, and produced a technical memorandum which assessed the suitability of each site and provided an overview description of vegetation and topography (NRM, 2008). NRM determined that most of the sites would be suitable reference sites, in the sense that they reasonably represented target conditions for the community type and were in landscape positions relatively similar to that at the project site. NRM suggested seeking out better examples of certain community types, most notably an example of a semi-permanent wetland suitable for California red-legged frog breeding. As part of expanding reference sites to encompass restoration targets at the project site, Winzler & Kelly and Swaim Biological identified more suitable semi-permanent wetland and native grassland sites. Reference sites are briefly described below based on April and May 2009 site visits and preliminary sampling by Winzler & Kelly. A technical memorandum characterizing reference sites in greater detail is included as Appendix E. Reference sites are being used to guide design, and not for success criteria which are instead based on features found on the project sites.

4.3 Reference Site Descriptions

4.3.1 Riparian Forest Reference Sites

Two riparian reference sites (R-1 and R-2) were characterized. Sites R-1 and R-2 provide a basis for riparian restoration along the southern margin of Adobe Gulch Grasslands. Site R-1 is located north of the Project Area west of the Filoli Gardens entrance off of Cañada Road. Site R-2 is located just northwest of the Project Area. Both sites are densely vegetated and have intermittent streams measuring approximately 10 to 20 feet across (bank to bank) running through the habitat. Dominant trees include coast live oak (*Quercus agrifolia*) and arroyo or red willow (*Salix laevigata* and *S. lasiolepis*). Several tree and shrub species are sub-dominant, and the herbaceous layer is relatively sparse.

4.3.2 Oak Woodland Reference Site

One coast live oak (O-1) and one mixed oak woodland reference site (O-2) were selected. Coast live oak woodland is present within the Adobe Gulch Grasslands site covered in this MMP.

4.3.3 Coastal Terrace Prairie Reference Site

One reference site (V-1) was selected for native grassland. The site is located immediately to the east of the Adobe Gulch Grasslands site, on the east side of the existing unimproved road to Upper Crystal Springs Reservoir. Some additional data were gathered near the northwest boundary of the site to increase the sample size and verify consistency across the site and at a slightly higher elevation. The reference site includes gently sloped terrain with a northwest aspect, and the supplemental data were gathered on a gentle southeast slope. The two sample plots were similar in species composition. The western plot is contiguous with the project site; the eastern plot is separated from the project site by a narrow unimproved road. During construction, temporary orange fencing is recommended to avoid any damage to these reference plots. At the reference site, dominant species include purple needlegrass and California oatgrass. Few good native grassland sites were identified during the search process, and most were at higher elevation or on steeper terrain. Reference Site V-1 will be used in the design of grasslands at the Adobe Gulch Grasslands site.

4.3.5 Seasonal Wetland Reference Site

One reference site (W-2) was selected, a sag pond, located adjacent to Old Cañada Road. The pond was dry in December, and with shallow (about six inches) water present in April and May. The entire pond is densely vegetated and is dominated by spikerush (*Eleocharis* sp.). The southern boundary is dominated by rushes (*Juncus* sp.) and the northern boundary is dominated by creeping wildrye (*Leymus triticoides*). The surrounding upland area includes coast live oak to the west and coyote brush (*Baccharis pilularis*) to the east.

Numerous Pacific tree frog (*Pseudacris regilla*) tadpoles and recent metamorphs were observed at this pond on May 6, 2009. This information is important for the design of seasonal wetlands at HRP sites, because successful recruitment of this species is an important factor in ensuring an adequate prey base for juvenile San Francisco garter snakes.

Site W-2 will serve as a reference site for proposed seasonal wetland creation and enhancement at the Adobe Gulch Grasslands site.

4.3.6 Semi-Permanent Pond Reference Site

One reference site was selected for the semi-permanent pond habitat. This site is located south of San Andreas Reservoir, and west-southwest of the terminus of Trousdale Road at Interstate 280. It is immediately adjacent to reference Site S-3. The pond provides habitat for both California red-legged frog and San Francisco garter snake (K. Swaim, pers. comm., and verified in the field by Winzler & Kelly in April and May of 2009). This reference site will serve as a

hydrological and vegetation benchmark to help guide design at other HRP sites, and will provide only supplemental information for the shallower and more ephemeral wetlands present or proposed at the Adobe Gulch Grasslands site. The reference site pond is not intended to be tied to success criteria, rather it is intended as a resource to document depth and pond duration of known habitat for target sensitive species, and for potential post-construction comparison in the event that adaptive management is required.

5.0 MITIGATION PROPOSAL

5.1 Basis for Design

The goal of the proposed project is to develop self-sustaining natural habitats and consolidate compensation for a variety of projects at one location to maximize overall habitat functions and values. The consolidation of compensation for several SFPUC projects will allow simultaneous development of multiple natural community types to create a functioning ecosystem. At Adobe Gulch Grasslands, specific goals are to provide mitigation for federally listed species, sensitive riparian habitat, waters of the U.S., and waters of the State and to create native grasslands. The Project intends to rehabilitate 49.7 acres of native grassland, enhance or establish 9.2 acres of oak woodland, enhance and establish 0.81 acres of seasonal wetlands, and to re-establish and establish 0.9 acres of riparian habitat.

Small areas of existing coastal scrub will be preserved. This mosaic of natural communities provides habitat for several protected species including the federally threatened and state endangered/fully-protected San Francisco garter snake, (*Thamnophis sirtalis tetrataenia*) (SFGS), and the federally threatened California red-legged frog, (*Rana draytonii*) (CRLF). Prior to Euro-American settlement these habitat types were more widespread in San Mateo County. Today these habitats are greatly reduced in extent and fragmented by development and successional changes. Nearby best-remaining examples of similar natural communities were identified as reference sites, and served as the basis for mitigation design and development of the planting palette.

The mitigation design will address current habitat limitations, including shrub encroachment which has shaded out the herbaceous understory and thus constrained cover availability for small animals. Bare soil under the shrub cover encourages rapid runoff of rainfall and is an erosion risk. Existing wetlands on the site are few and widely separated, thus limiting amphibian reproduction, turtle foraging or basking, and garter snake foraging. By returning the site to the more open grassland condition evident in old (1956) aerial photographs and suggested by early (1850s) Government Land Office surveys, habitat conditions for native wildlife will be diversified and water will be retained for a longer duration on site.

5.2 Project Goals

An overall goal of the Adobe Gulch Grasslands project is to consolidate habitat creation, restoration and enhancement activities at one location to mitigate impacts from multiple projects. Specific goals include:

1. Protect or restore native biodiversity, resulting in a net gain of good quality native habitat;
2. Protect or enhance sensitive species and their habitats;
3. Protect, restore, or mimic ecological processes, to the extent practicable;
4. Increase the area of native grassland and oak woodland habitat;
5. Increase the area of wetland and riparian habitat;
6. Increase the area of seasonal inundation.

5.3 Target Habitats

Plant community types to be established, re-established, rehabilitated, or enhanced include coastal terrace prairie, freshwater marsh (seasonal wetland), enhance and establish coast live oak woodland, willow riparian forest, and coast live oak riparian forest.

5.4 Target Species

The long-term goals above have been identified based on an analysis of habitat requirements of the target species, including San Francisco garter snake and California red-legged frog, optimal native plant community compositions, essential ecosystem processes to maintain the habitat and plant communities, and long-term self-sustainability.

The target species were selected because of their federal or state protected or sensitive status, because SFPUC projects may impact these species, and because as sensitive species they serve as indicators of overall community and ecosystem level quality.

Although not specifically targeted for this project site, two state special concern species, the western pond turtle and San Francisco dusky-footed woodrat, are known to occur nearby, and may benefit from mitigation activities. Two listed invertebrates, the Mission blue butterfly and the Bay checkerspot butterfly, may have historically occurred in the general vicinity and may also benefit from the proposed project.

The following accounts summarize known habitat needs and other relevant information for the species identified above. Nomenclature follows CDFG (2008).

San Francisco Garter Snake, *Thamnophis sirtalis tetrataenia* (Federal Threatened, State Endangered, State Fully Protected)

Breeding habitat for the San Francisco garter snake includes "grassy uplands and shallow marshlands with adequate emergent vegetation, and the presence of both Pacific tree frog (*Pseudacris regilla*) and California red-legged frog breeding populations" (USFWS 2006; McGinnis, 1987). A grassland-shrub matrix with an average of one shrub per 20-30 square meters is thought to provide cover from predators as well as open areas for thermoregulation (Barry, 1994). Understory (bunchgrasses or litter) height of at least 20 cm may be a requirement for cover as well (Barry, 1994). Management techniques to maintain open areas may include light grazing or prescribed fire.

Burrows of rodents and other small mammals are used as hibernacula (Larsen 1994) and also

provide cover at other times of the year (USFWS, 2006). Burrowing mammals also play a role in maintenance of open grassland habitat by moving nitrogen-poor subsoils to the surface, thus encouraging patches of early successional habitat (Stromberg and Griffin, 1996).

Aquatic habitats supporting San Francisco garter snakes typically include areas of emergent vegetation such as cattails (*Typha* spp.), spike rush (*Eleocharis* spp.), and water plantain (*Alisma* spp.); where emergent vegetation is not present, bordering willows (*Salix* spp) may serve as cover (Larsen, 1994; Barry, 1994). Areas of open water may also be important to sustain the tadpole prey base (USFWS, 2006). Studies elsewhere have shown that excessive woody canopy shading of ponds can reduce food availability for tadpoles and eventually lead to local extirpation of some anuran species (Werner and Glennemeier, 1999).

Shallow wetland margins are thought to be an essential habitat component, because San Francisco garter snakes are more efficient at capturing prey in water less than 5 cm deep (Larsen, 1994). Shallow wetland margins also have a greater frequency of suitable basking locations for snakes (Freel and Giorni, 1994).

Removal of non-native trees and creation of additional wetland will both enlarge and improve the quality of onsite habitat for this species by providing greater structural habitat diversity, decreasing shade, and increasing the prey base.

The nearest known occurrence of San Francisco garter snakes from the project site is at Upper Crystal Springs Reservoir approximately 0.1 miles east of the site (Swaim Biological, 2008). Although not yet documented within the site boundary, reducing the dense shrub canopy and expanding the amount of grassland and wetland habitat is likely to encourage dispersal into the mitigation site.

California Red-legged frog *Rana draytonii* (Federal Threatened)

California red-legged frogs breed throughout the rainy season (November to April), with the exact timing varying depending on location and elevation (Storer, 1925). Most eggs are reportedly deposited in March; at Homestead Pond four miles to the southeast, egg masses have been observed on February 19 and March 13 (Swaim, 2008). Eggs are deposited on the surface of the water but attached to emergent vegetation (Hayes and Miyamoto, 1984). The eggs hatch in 6 to 22 days, and the tadpole stage is relatively long at 11 to 20 weeks (Jennings, 1988; Bobzien et al, 2000; Storer, 1925; Wright and Wright, 1949). Even longer intervals in the tadpole stage have been reported, including overwintering tadpoles noted in the East Bay Area (Bobzien et al., 2000).

California red-legged frogs utilize a variety of habitat types at relatively low elevations (usually below 1,000 meters). Breeding may occur in “streams, deep pools, backwaters within streams and creeks, ponds, marshes, sag ponds, dune ponds, and lagoons” (USFWS, 2002). In streams, deeper areas with slow flow and emergent vegetation may be preferred; however streams are subject to variable flow in the spring, and storm flows may pose some risk to eggs or recently hatched tadpoles (USFWS, 2002). During the day, frogs utilizing streams in Marin County tended to be in or near pools more than 0.5 m deep and with root wads, logjams, or overhanging banks; or on the banks up to 2 m from the water, and under dense vegetation (Fellers and

Kleeman, 2007). Ponds, both natural and man-made, are also used for breeding. Frogs were observed under deep water, on banks, or in seasonal wetlands under dense vegetation (Fellers and Kleeman, 2007). Jennings and Hayes (1994) noted the importance of shrubby riparian vegetation, such as arroyo willow thickets, as well as cattail and bulrush (*Scirpus* sp.).

Movement through upland habitat is fairly common, and may extend for distances up to at least 1.6 km (1 mile). Fellers and Kleeman (2007) found that in Marin County, some individual frogs remained at or near aquatic breeding sites all year, but that 66 percent of females and 25 percent of males moved through upland habitat. The greatest straight-line distance moved over a season was 1.4 km. Short movements were noted throughout the year, but movements of more than 30 m were often associated with winter rainfall. When longer movements did occur in the dry season, they usually were prompted by the seasonal drying of a water body. Long-distance movements through open grasslands were common, although multi-night movements tended to follow riparian corridors

The California red-legged frog has suffered from “elimination or degradation of habitat from land development and land use activities and habitat invasion by non-native aquatic species” (USFWS, 2002). Specific threats in the Bay Area include habitat loss or fragmentation, predation by introduced bullfrogs, alterations of flow regime or hydrology, mortality resulting from automobile traffic in areas where roads cross dispersal corridors, and spread of chytrid fungus.

Expansion of oak woodland, riparian, seasonal wetland and grassland habitats will offer additional foraging areas for this species. Removal of non-native trees will reduce partial barriers to distribution by providing new herbaceous cover in areas presently almost barren at ground level.

The California red-legged frog is known to occur at a number of localities throughout the Peninsula holdings. Adults and tadpoles have been observed at several locations during HRP-related field work (Leitner and Roberts, 2008; K. Swaim, pers. comm.; K. Mierzwa, pers. obs.). The closest documented presence is along Upper Crystal Springs Reservoir approximately 0.1 mile east of the site (Swaim Biological, 2008). Proposed seasonal wetland and riparian restoration will expand available foraging and dispersal habitat for this species.

Mission Blue Butterfly, *Icaricia icarioides missionensis* (Federal endangered)

This species may have historically occurred in the general project vicinity, although the nearest recent records are on SFPUC Peninsula holdings several miles to the north. Various species of lupine are the host plants; lupine reportedly occurs in remnant grassland openings on the eastern end of the project site (ESA, 2009). Existing stands of lupine will be mapped and protected with orange fencing, and two species of lupine are included in the supplemental butterfly mix to enhance potential habitat in case of dispersal by the Mission blue butterfly.

Bay Checkerspot Butterfly, *Euphydryas editha bayensis* (Federal endangered)

This species historically occurred east of the project site on the serpentinite-derived soils of Pulgas Ridge. The nearest extant populations are several miles to the south at Edgewood Preserve, where the species was extirpated in 2002 and then re-introduced in 2007. Although

occurrence at the project site is thought to be unlikely, host and nectar plants have been included in the grassland seed mix in the event that dispersal does occur in the future.

San Francisco Dusky-footed Woodrat, *Neotoma fuscipes annectans* (State Species of Special Concern)

This subspecies occurs around the southern part of the San Francisco Bay area. Large permanent stick nests are built, often within riparian forest. Related and more widespread subspecies also utilize a variety of upland shrub and woodland community types.

A woodrat nest has been observed near the eastern limit of the Adobe Gulch Grasslands site, and others are likely present (Winzler & Kelly unpublished field observations, 2009).

Saltmarsh Common Yellowthroat, *Geothlypis trichas sinuosa* (State Species of Special Concern)

This subspecies is a primary year round endemic resident to California and primarily breeds in the San Francisco Bay region, though the overall range is static, some birds migrate south to San Diego in the winter. This bird can be observed in wetland and riparian habitats. This species can often be found occupying the ecotone linking drier uplands with mesic areas of wetlands and riparian corridors.

Nesting populations of the saltmarsh common yellowthroats have been documented in freshwater marshes within 0.2 miles southeast of the Adobe Gulch Grassland Restoration (ESA+Orion, 2009; CDFG, 2008).

Western Pond Turtle, *Actinemys marmorata* (State Species of Special Concern)

Western pond turtles are known to occur in the sheltered cove southeast of the Adobe Gulch Grasslands site, and at various other locations within and near Upper Crystal Springs Reservoir (Winzler & Kelly field observations, 2009). Although no suitable permanent aquatic habitat occurs within the proposed project site, it is possible that adults may occasionally nest in the eastern part of the site.

This species inhabits permanent and semi-permanent aquatic habitats with slow or no flow. Highest densities are reported to occur where basking sites are common (Jennings and Hayes, 1994), although to some extent this may be due to a higher probability of observation of basking turtles. Eggs are deposited in relatively dry and open upland sites, sometimes on south-facing slopes, and sunlight may be essential to maintain adequate thermal conditions for egg incubation. Nests are generally on slopes of less than 25 degrees (Jennings and Hayes, 1994). Most nesting sites are within 200 meters of a pond, although a few nests have been reported at much greater distances (Storer, 1930). Hatchlings require relatively shallow water with dense emergent or submerged vegetation (Jennings and Hayes, 1994).

Adult turtles are capable of long-distance movements (2 km or more; Jennings and Hayes, 1994) but movements away from ponds are rare except for nesting or when water sources become dry (Rathbun et al, 1992, 1993). Overwintering may occur on land or in the water; in mild coastal locations such as the project area, occasional winter activity may occur (Rathbun et al. 1993).

Removal of dense shrub cover will open up travel corridors to additional potential nesting sites and facilitate dispersal. Enhancement and creation of wetlands may provide aquatic habitat for juvenile turtles.

5.5 Target Communities

Because of the habitat requirements of the species discussed above, and existing habitat features at the site, the following plant communities and habitat types are targeted for creation and enhancement.

These community types are summarized below along with brief comments on their relative quality and importance for sensitive species. Community classification follows Holland (1986). The diverse array of woodland, grassland, scrub, and wetland communities found within the site is capable of supporting a species-rich wildlife assemblage; for example, some of the sensitive species known to occur on the site utilize more than one community type, and each uses a different combination of habitats. However, the relatively degraded quality of some habitats due to fire suppression, hydrological alteration (channelization, excavation, and increased evapotranspiration), invasion of non-native species, and other factors currently limits the value of the site. Planned habitat creation and enhancement will increase both the area and quality of habitat for sensitive species.

Table 2 – Adobe Gulch Grassland Existing and Post-Project Habitat

	Pre-project	Pre-project	Post-project	Post-project	Net Change
	Area (acres)	Distance (LF)	Area (acres)	Distance (LF)	Area (acres)
Northern coyote brush scrub	31.5	-	2.81	-	(34.3)
Coastal Terrace Prairie – re-established	19.5	-	46.7	-	35.3
Seasonal wetlands – enhanced	0.20	-	0.20	-	-
Seasonal wetlands - established	-	-	0.61	-	0.30
Coast live oak woodland – enhanced	7.01	-	7.0	-	-
Coast live oak woodland – established	-	-	2.2	-	2.9
arroyo willow riparian – re-established	-	-	0.5	1,135	0.5
oak/riparian forest – established	-	-	0.4	1,150	0.4
Monterey cypress/Monterey pine	2.21	-	-	-	(2.3)
TOTAL	60.42	-	60.42	2,285	-

Definitions for types of compensatory mitigation follow U. S. Army Corps of Engineers (2006), except that the definitions are here applied to upland as well as aquatic habitats:

Enhancement means the manipulation of physical, chemical, or biological characteristics of a resource to heighten, intensify, or improve a specific resource function(s). Enhancement results

in the gain of selected resource function(s), but may also lead to a decline in other resource function(s). Enhancement does not result in a gain in resource area.

Establishment (creation) means the manipulation of the physical, chemical, or biological characteristics present to develop a resource that did not previously exist at the project location. Establishment results in a gain in resource area.

Preservation means the removal of a threat to, or preventing the decline of, resources by an action in or near those resources. This term includes activities commonly associated with the protection and maintenance of aquatic resources through the implementation of appropriate legal and physical mechanisms. Preservation does not result in a gain of resource area or functions.

Re-establishment means the manipulation of the physical, chemical or biological characteristics of a site with the goal of returning natural/historic functions to a former resource. Re-establishment results in rebuilding a former resource and results in a gain in resource area or functions.

Rehabilitation means the manipulation of the physical, chemical, or biological characteristics of a site with the goal of repairing natural/historic functions to a degraded resource. Rehabilitation results in a gain in resource function but does not result in a gain in resource area.

Restoration means the manipulation of the physical, chemical, biological characteristics of a site with the goal of returning natural/historic functions to a former or degraded aquatic resource. For the purpose of tracking net gains in aquatic resource area, restoration is divided into two categories: reestablishment and rehabilitation.

5.5.1 Riparian

Central coast arroyo willow riparian forest and central coast live oak riparian forest occur near the Adobe Gulch Grasslands site, and the existing southern boundary road appears to occupy the location of an historic seasonal channel which will be restored as part of this project. Riparian forests provide important habitat for California red-legged frogs, San Francisco garter snake, saltmarsh common yellowthroat and San Francisco dusky-footed woodrats. The project will re-establish this habitat type, which was present within the site historically, along the eastern portion of the existing road; and establish a more ephemeral variant on the western part of the road.

5.5.2 Oak Woodland

Coast live oak woodland is present onsite. Oak woodlands of good quality may provide terrestrial habitat for several sensitive species, including San Francisco dusky-footed woodrat, San Francisco garter snake and California red-legged frog. The Western leatherwood is a special status shrub that has been observed in the Adobe Gulch Oak Restoration and has potential for habitat to be present in the Grassland restoration area, though no individuals were observed during field surveys. However, the oak woodlands on the site have been degraded and fragmented by encroachment of dense shrub cover and by invasive species such as periwinkle.

The project would remove shrubs and invasive species from the understory of existing oak woodlands, and plant oaks where non-native pine and cypress are removed. This would reduce shading and suppression of oak seedlings and encourage formation of a native herbaceous understory which would provide cover for wildlife and reduce runoff and erosion risk.

5.5.3 Northern Coyote Brush Scrub

This community type presently dominates the site, and is far more extensive than it was historically as a result of fire suppression. Small, scattered patches of coyote brush have been identified as an element of San Francisco garter snake habitat, providing cover from predators (USFWS, 2006); however, dense stands shade out herbaceous species and reduce available sunlight, limiting opportunities for thermoregulation. Large dense stands like those currently present on large parts of this site can exclude the San Francisco garter snake. Although not a target habitat, the project would maintain patches (~5% cover) of this habitat types within a balanced mosaic, rather than as the homogenous stand which is currently present.

5.5.4 Coastal Terrace Prairie and Grasslands

Numerous small grassland openings persist especially in the northern and central parts of the site, and many of these retain a high percentage (about 50% cover) of native species. With management to enhance native grassland structure, these can provide important basking and foraging habitat for San Francisco garter snake and California red-legged frog, and upland nesting habitat for the western pond turtle. The project would expand and connect remnant grassland openings, with a net gain in the amount of a habitat type which was once locally abundant but is currently not widespread in the project vicinity.

5.5.5 Seasonal Wetlands

Seasonal wetlands on the site provide important habitat for San Francisco garter snake, California red-legged frog, and western pond turtle. The hydroperiod of these wetlands has been reduced by evapotranspiration and diversion of water through tire ruts and roadside ditches. Proposed establishment and enhancement activities are expected to result in a net gain of jurisdictional wetland area, and more diverse, longer lasting, and higher quality wetland communities offering improved habitat for sensitive species. Proposed mitigation activities will lengthen the hydroperiod of existing wetlands by reducing evapotranspiration and slowing runoff, and create new seasonal wetlands, potentially increasing survival of Pacific tree frog tadpoles, and also providing foraging habitat for California red-legged frogs, San Francisco garter snakes, saltmarsh common yellowthroat and western pond turtles; and reduction of adjacent shrub cover will increase available sunlight to wetlands, encouraging increased cover of emergent and submerged aquatic vegetation.

6.0 IMPLEMENTATION

6.1 Site Preparation

6.1.1 Overview

Target creation and enhancement acreages are identified below for each habitat type.

Approximately 49.7 acres of coastal terrace prairie will be enhanced or rehabilitated through removal of shrub and non-native tree cover and re-seeding of native grassland species into bare patches.

A 2.21-acre stand of mature Monterey cypress and Monterey pine at the western edge of the site will be removed, and replanted with coast live oak woodland. There is a heritage oak to remain within this cypress complex which will be flagged to be left unharmed. An existing 5.46 acre stand of coast live oak woodland in the southern part of the site will be enhanced by removal of invasive species such as periwinkle in the understory and planted with native understory material. Smaller clusters of oaks in the western and central parts of the site will be preserved and habitat enhanced through removal of competing young cypress trees; additional oaks will be planted where non-native trees are removed. The total area of enhanced or established oak woodland will be approximately 9.22 acres.

Approximately 0.2 acres of existing seasonal wetlands in the southern part of the site will be enhanced by increasing the cover of desirable hydrophytic native species. Two new seasonal wetlands will be established. One, immediately west of the seasonal wetland to be enhanced, would be approximately 0.3 acres. Another, approximately 0.31 acres is to be established at the eastern end of the site.

The existing unimproved road forming the southern boundary of the site would be abandoned and converted into a riparian corridor. The lower (eastern) half, 1,135 feet in length, would be excavated into a shallow, meandering channel sufficient to hold flow currently pooled in the road or in small bordering ditches or tire ruts. Areas bordering the newly created channel would be planted with characteristic riparian species. The upper half of the road, 1,400 feet in length, would be excavated into a shallow swale, intended to funnel ephemeral runoff into the lower channel and supporting a lesser amount of riparian vegetation. The swale would leave the road before reaching a steeper segment, with flow joining a small riparian corridor just to the south. That corridor rejoins the road just to the east, and is one of the water sources for the proposed lower riparian restoration segment.

Material excavated as part of the riparian restoration, from the unimproved road forming the southern boundary, would be in part re-used as part of riparian grading, but most would be hauled off site. A grading plan and cross sections are shown on Figures 10a through 10f. Acreages of created and enhanced plant communities are shown below in Table 2. For planning purposes, the site has been divided into three major management units (east, central, and west) following northwest-southeast trending sub-watershed boundaries (Figure 12).

The project would include the specific implementing components described below.

6.1.2 Native Species Protections and Exclusions

To minimize effects on desirable habitats and species, avoidance measures will be implemented. Temporary access lanes and staging areas will be identified, and equipment movement will be restricted to these areas. Staging will occur near the northwestern corner of the site, immediately adjacent to Old Cañada Road.

Grading limits will be clearly defined and identified to prevent damage to existing wetlands or good quality upland habitat. Grading would be limited to the margins of the site, including new riparian and wetland areas in and immediately adjacent to the existing southern boundary road, and improvement and extension of a road along the northern boundary. Exclusion fencing will protect good quality habitat including existing wetlands. Access routes for equipment will be limited to upland areas. The area of excavation will be approximately 1.0 acre. Excavated material will be re-used on-site to the extent practical, including for construction of low berms along new riparian areas. Excess material will be removed from the site. Native trees, especially oaks, will be protected as much as possible during cypress, pine, and shrub removal. Impacts to native bunchgrass grassland will be minimized, although some limited disturbance is likely during shrub removal. Temporary impacts will be mitigated through restoration activities including revegetation with native species. The temporary loss of habitat will be compensated by reducing the amount of habitat credit available to compensate other SFPUC projects. Anticipated limits of ground disturbance are shown in Figure 9.

6.1.3 Clearing Woody Vegetation

A large portion of the Adobe Gulch Grasslands site would first be cleared of woody vegetation, mainly Monterey pine, Monterey cypress, coyote brush, and poison oak (*Toxicodendron diversilobum*). Prior to intensive clearing, goats may be used to open up the scrub and improve access for workers. It may be necessary to hand clear pathways for temporary fencing to impound goats within the site and to graze the site in smaller units to limit the amount of temporary fencing needed.

Approximately 90 mature cypress and pine trees along the western edge of the site will be cut, with the stumps left in place. Cut trees would be removed from the site. Every effort would be made to avoid damage to a large, mature coast live oak near the southwest corner of the site, as well as several smaller oaks found within this area. The northwest corner of the site would serve as the staging area, with easy access to the existing northern and southern unimproved access roads. The new northern access road would be cleared early in the process, extending all the way to the eastern corner of the site, to clearly delineate the limits of work. Subsequently, clearing would move into the interior of the site. Hand clearing would be utilized in areas with at least 5-10% herbaceous cover, on steep slopes and within or at the edge of good quality remnant grassland openings, to minimize soil disturbance. Areas of nearly complete shrub cover with little herbaceous understory would be mechanically cleared, with access routes avoiding remnant native grassland. Most woody cover, including small cypress, pine, and scrub, would be removed. Oaks would be left undisturbed, with clearing of immediately adjacent vegetation to be done by hand. A small number of native shrubs or small trees (approximately 5 percent cover) would be left in place to provide cover for garter snakes and other wildlife. Areas to be cleared by hand and mechanically are identified in Figure 9.

In general, the following sequence of clearing is envisioned:

- Clear staging area
- Clear new northern access road
- Clear wetland and riparian excavation areas
- Clear sub-watershed boundaries and adjacent open grassland patches of sparse scrub (by hand) and install exclusion fencing near dense scrub edges
- Clear east unit (mechanically)
- Clear central unit (mechanically)
- Clear west unit (mechanically)
- Cut and remove large cypress/pine at western edge of site

Exclusion fencing will be installed surrounding each large block of scrub habitat. Mechanical clearing, using a Bron 400 or equivalent, will begin from one end of each unit. A biological monitor would be present during clearing, and would visually investigate under the scrub. Clearing would occur to the limits of confidence determined by the monitor. Then clearing would pause while the monitor inspects the next swath of scrub to be cleared. Although it is unlikely that SFGS or CRLF would be present within the densely shaded interiors of scrub patches, this approach would allow for animals to move away from disturbance and exit through a one-way funnel trap or other mechanism allowing outward passage through the exclusion fence. The exclusion fence would also prevent any new animals from entering into the work area or into the area already cleared.

If any San Francisco dusky-footed woodrat nests are encountered within scrub thickets, they will be identified by the biological monitor and a buffer zone flagged. The nest would be bypassed and left in place, and the biological monitor would make a recommendation on whether to relocate the nest at a future date or leave it in place.

6.1.4 Grading

Existing hydrology and drainage patterns, as well as the presence or potential presence of cultural resources, seasonal wetlands, and endangered species habitat, will seasonally restrict grading for riparian restoration and seasonal wetland creation. Grading and limited excavation is proposed along the existing unimproved road on the southern boundary of the site to re-establish riparian habitat, and near the southern edge to create shallow seasonal wetlands. Equipment will enter on the existing access roads, and work within the presently disturbed areas. The wetland pond area should be excavated down to the clay loam horizon (dense clay loam horizon approximately 13 to 18 inches depth) or down to the clay layer (approximately 3 feet depth) to avoid intercepting the sandy clay loam or sandy clay layer as the bottom of the pond. If excavating down to 3 feet depth to utilize the clay horizon as a pond liner, stockpile dark surface soil to allow addition of dark A horizon from stockpiled material to promote plant growth. This can also be if only excavating to approximately 13 inches to reach the clay loam horizon as well, but the additional layer of top soil must be thin enough to keep the wet weather groundwater table within 12 inches of the service.

Grading of the new riparian channel will incorporate measures to slow channel flow and grade control to minimize the risk of erosion. The new channel will avoid existing seasonal wetlands, leaving an area of higher ground between the channel and the wetland basins. The lower (eastern) 1,135 feet of riparian restoration would include a well defined channel, with a 1,150 foot long upper (western) reach consisting of a shallow swale intended to collect ephemeral flow and feed it into the wetter lower reaches.

The grading plan and cross sections are shown on Figures 10a through 10f for the two new seasonal wetland basins, two sections of proposed riparian channel, and the new northern access road.

6.1.5 Soil Disposal

Soil excavated to create the new oak riparian corridor and seasonal wetland will be re-used on-site to the extent possible. The excavated soil will primarily be used to construct a low berm along the western part of the new riparian channel and possibly to create benches in the wetlands. Based on the 65% design documents, we have a total of approximately 1,400 cubic yards of soil being placed on the oak riparian area and 7,600 cubic yards that need to be off hauled/disposed elsewhere. The re-used soil will be hauled and placed in the new riparian corridor being established.

The new road is already on generally high and well-drained ground. The new access road is not using any fill because it is being built on a natural ridge, so there is no location on the new road that needs fill. Alterations to the existing road, such as the use of rolling dips spaced every 400 linear feet and an outsloped road surface will be designed to ensure avoidance of impacts from erosion and sedimentation (Keller, G., J. Sherar. 2003). Material will be graded to a level elevation, as nearly as practical. The road is expected to be level with or only slightly higher than surrounding terrain after soil grading, thus it will not create a barrier to wildlife movement or precipitation runoff. Once the road is graded, it will be planted with an erosion control mix. Reuse of the soil material onsite will minimize construction time and expense, and will reduce the number of truck trips necessary to haul material offsite. However some excess material would be hauled offsite for disposal. The left over soil for disposal will be placed in a dump truck with a screen to cover the soil so no material will be lost during transport. Although local grading may be necessary in selected locations to repair damage associated with tree or shrub removal, no other soil disposal is anticipated.

6.1.6 Soil Treatment

Soil fertility samples were collected at four locations at the Adobe Gulch Grasslands project site (Figure 5). Three subsample locations were selected in the area for shrub removal/grassland restoration. These subsamples (SP-1a, SP-1b, SP-1c) were composited at a 3:1 ratio for laboratory analysis. A fourth sample was selected in the proposed wetland area (SP-3). The soil was characterized in an eroded ditch from the profile face in the area proposed for riparian plantings (SP-2, no sample was collected from here as soil fertility for growing riparian vegetation is not considered a concern at this site).

The following recommendations are provided for consideration during the design and implantation of proposed site activities:

- Soil fertility guidelines for use of these soils to support grassland (soil pit SP-1), recommends amending the soil with up to 100 pounds per acre gypsum to raise the calcium level from very low, and to provide an improved balance with magnesium (very high rating). The calcium to magnesium ratio is out of balance but native bunch grasses should be tolerant of local soil conditions.
- The fertility guidelines, according to the A & L Western Agricultural Laboratories, also recommend adding a nitrogen/phosphorus/potassium fertilizer, but this is not recommended for this site as it could stimulate invasive species and shrubs species. The high organic content of the soil will provide some nutrients for proposed native plantings. Adaptive management should be used to determine post-planting if particular nutrients are inhibiting plant growth, and will be evaluated during the annual monitoring.
- Conclusion: Although the lab recommends applying soil amendments, the application of amendments may affect the pH of the water, cause eutrophication, and nutrients could move offsite due to water movement. Nutrient use could also encourage growth and completion of invasive species.
- Based on results and interpretation of these samples, no treatment is recommended for project site soils.

Detailed soil fertility information is included as Appendix C.

6.1.7 Invasive Plant Control and Undesirable Native Species Plant Control

Re-establishing native coastal prairie grassland is a goal for this plan. Invasive management and undesirable native plant competition is a major factor to consider throughout the mitigation timeframe and extending into long-term management timeframe. In order to allow the low vigor, slow germinating native seeds and acorns to grow, intensive invasive species management and weed control are required to compete against the vigorous, quickly germinating, high density non-native annuals. The main factors to establish native grasses are to ensure adequate sunlight, soil moisture, and nutrients are available for the seeds to mature-some of which require two to three years to become vigorous individuals (Anderson, 2010).

A variety of techniques have been studied in central California grasslands and the literature documents that a combination of techniques will yield the most successful results. The combined methods include herbicides (pre and post), mowing, grazing, and burning/flaming. Because of regulatory and other constraints, some methods may not be available for use at the Adobe Gulch site. Weed competition is a major factor to consider throughout the mitigation timeframe and extending into long-term management timeframe. In order to allow the low vigor, slow germinating native seeds to grow, intensive invasive species management and weed control are required to compete against the vigorous, quickly germinating, high density non-native annuals. The main factors to establishing the native grasses are to ensure adequate sunlight, soil moisture, and nutrients are available for the seeds to mature some of which require two to three years to become vigorous individuals (Anderson, 2010).

Invasive species control will be necessary prior to project implementation. Invasive control should be planned ahead of time and could be started prior to anticipated initial planting.

6.1.7.1 Target Invasive Plant Species

Target species for non-aquatic, upland habitats are species with high or moderate impacts rankings in the California Invasive Plant Council's (Cal-IPC) Central West list (excluding those listed as exempt below), as well as those species that are rated as high or moderate by the Cal-IPC list in the future (but excluding species that are considered to appear rarely in monotypic stands or to have low/minor impacts in our region).

Target invasive species for wetland habitats, riparian habitats, and other aquatic habitats regulated by USACE, RWQCB, and CDFG are the same as for non-aquatic/upland habitats, with the addition of the species ranked as Tier 1 and Tier 2 in the Water Board's Fact Sheet for Wetland Projects <http://www.waterboards.ca.gov/sanfranciscobay/certs.shtml>.

Scientific Name	Common Name	Cal-IPC rating	Considered a Target Invasive by SFPUC?	Rationale for not being considered exempt from the list of target invasives in non-wetland areas
<i>Brassica nigra</i>	black mustard	Moderate	N	Widespread. Primarily a weed of disturbed sites, but can be locally a more significant problem in wildlands.
<i>Bromus diandrus</i>	ripgut brome	Moderate	N	Monotypic stands uncommon.
<i>Cynosurus echinatus</i>	hedgehog dogtailgrass	Moderate	N	Impacts vary regionally, but typically not in monotypic stands.
<i>Erechtites glomerata</i> , <i>E. minima</i>	Australian fireweed, Australian burnweed	Moderate	N	Impacts low overall. May vary locally.
<i>Hordeum marinum</i> , <i>H. murinum</i>	Mediterranean barley, hare barley, wall barley	Moderate	N	Generally do not form dominant stands.
<i>Hypericum perforatum</i>	common St. John's wort, klamathweed	Moderate	N	Abiotic impacts low.
<i>Hypochaeris radicata</i>	rough catsear, hairy dandelion	Moderate	N	Impacts appear to be minor.
<i>Lolium multiflorum</i>	Italian ryegrass	Moderate	N	Impacts vary with region.
<i>Rumex acetosella</i>	red sorrel, sheep sorrel	Moderate	N	Widespread. Impacts vary locally.
<i>Trifolium hirtum</i>	rose clover	Moderate	N	Impacts relatively minor in most areas.
<i>Vulpia myuros</i>	rattail fescue	Moderate	N	Rarely forms monotypic stands

Invasive or non-native plants currently present on the site that will need to be removed include French broom (*Genista monspessulana*), pampas grass (*Cortaderia selloana* and *C. jubata*), slender oats (*Avena barbata*), periwinkle (*Vinca major*), velvet grass (*Holcus lanatus*) and Harding grass (*Phalaris aquatic*) (ESA, 2009). Additional invasive plants may be identified during site clearing and construction. The following management tools will be adequate to address species that are found during project implementation (see long term management section).

6.1.7.2 Undesirable Native Species Plant Control

Undesirable native plant control refers to the species that are native to California, yet are not native in the Peninsula watershed; or are reproducing at high rates because historic management techniques no longer occur within the project boundary. These plants are thought to be invading certain ecotypes where they out-compete desirable native plant communities and their habitat niches including grasslands.

The following plants are native to California, but need to be managed to promote grassland habitats: Monterey cypress (*Cupressus macrocarpa*), Monterey pine (*Pinus radiata*), coyote brush (*Baccharis pilularis*), and poison oak (*Toxicodendron diversilobum*). These pioneer trees and shrubs are undesired native plant species intruding on native grassland habitats on this project site. The following management tools will be adequate to address both non-native and undesirable native species that are found during project implementation. It is likely that at least a few additional invasive species will be identified during pre-construction surveys.

Management of selected native species will also be required to allow oaks and other planted species to become established. Soil moisture may be attributed to the insufficient recruitment of oaks where annual Mediterranean grasses dominate and depleted water availability in the soil profile in the spring. This is an important factor when considering seedlings are sending down their roots in a competitive floristic habitat. For these reasons it is important to implement the invasive management plan and follow-up treatments to increase survivorship of planted container stock, acorn seedlings and natural recruitments. There has been a clear distinction between alien annual grasses and the success of oaks establishing amongst native perennial bunch grasses. Therefore, as the invasive weeds are removed from the site, the niche will be filled with a variety of native grasses. Some of the management strategies identified below would be effective in suppressing resprouting of coyote brush, poison oak, and other aggressive native shrubs; while allowing desired plant stock to take root.

Competition from invasive plants, and naturalized weeds can be a problem when re-vegetating a site. Applying a pre-emergent weed control on the site prior to grading activities can greatly increase the survivorship of new plantings. This action will also reduce the transfer of weed seeds attached to equipment, due to ground disturbance caused by grading activities. The pre-emergent will reduce the naturalized and invasive herbaceous plants on site by prohibiting seedling germination of the undesired plants through an approved herbicide. The pre-emergent herbicide should be applied before undesired plants emerge for this control method to be considered successful. Heavy rains may reduce the success of the application as it dilutes the effectiveness of the herbicide. Milestone (active ingredient Aminopyralid, triisopropanolamine

salt (5928) 40.6%) can be used as an herbicide on the Adobe site and can be applied in the fall. This herbicide is applied at 4-7 ounces per acre using a broad spray treatment to control annual, perennial, and biennial weeds. This herbicide has a wide window for applications and can be applied up to the fall. An additional approved herbicide restricted to a subset of San Francisco's "Reduced Risk" Pesticide List:

- o Eugenol (clove oil) 21.4%; 2-phenethylpropionate 21.4% (EcoEXEMPT™)
- o Triclopyr (Garlon 4)

If construction schedules preclude application of a pre-emergent herbicide to suppress weeds on the site, it is recommended to mow accessible areas before the weeds set seed prior to grading activities. Mowing should be employed several times during the growing season to reduce seed set. A follow-up post emergent herbicide should be applied in the fall before re-vegetation activities commence. By controlling herbaceous weeds the growth and survival of newly planted or seeded material will be greatly enhanced.

Mechanical removal, including hand pulling and mowing, will be the primary means of removing and controlling invasive vegetation. In addition to mechanical methods, fire should be included as a long-term management technique to ensure success of the stated project goals by mimicking the historical maintenance regime of native grasslands. For best results, a combination of a natural herbicide, mowing, hand pulling, mechanical clearing, fire, tree shelters, and re-seeding will yield the most successful results in the re-vegetation plan and reduction of non-native plants.

Below, several strategies are described in more detail that could assist in addressing the issue of specific invasive species at the project site, both before initial planting as well as during the monitoring phase. In many cases, multiple strategies combined will be most effective in eliminating specific unwanted species from the project site, and in all cases monitoring and adaptive management will be key to long-term success of the restored habitats and elimination of invasive species. Once the native target species are established, it is anticipated that they will out-compete the invasive species. After the general strategies discussion below for invasive control, individual invasive species known to occur at the project site are addressed in the context of which strategy(s) should be considered for feasible elimination of that species.

6.1.7.3 Invasive Species Removal Strategies

Herbicides

To comply with City and County of San Francisco (CCSF) requirements for CCSF owned property, use of pesticides (including insecticides, herbicides/weed-killers, fungicides, rodenticides) should be employed as a method of last resort for pest removal, and only after exploring all applicable non-chemical options. Only products listed on the San Francisco Reduced-Risk Pesticide List (RRPL) (<http://www.SFEnvironment.org/ipmchecklist>) may be used on CCSF-owned properties (SF Environment Code, Chapter 3), and must be used in a manner consistent with limitations described on the RRPL and the US EPA label (Table 3). Herbicides listed on the 2009 RRPL that may be used at the project site for invasive species removal are summarized in the table below (Year 2010 list should be consulted when published prior to project implementation), and precautions for use in California red-legged frog habitat are noted

in the “Limitations / Notes” column. Only herbicides approved by USEPA for aquatic use will be used near wetlands.

Given the City’s direction to consider other feasible options first before defaulting to herbicide use, other strategies discussed below could be utilized as initial procedures to knock down the dominant invasive plants in advance of planting, relying on a pre-emergent herbicide to be used at time of planting to address the seed bank stored in the soil that will regenerate. As well, subsequent applications of herbicides and/or strategies discussed below may be employed as part of an adaptive management strategy. Herbicides will be hand painted on stems or stumps or injected, when used, near wetland, riparian areas, and areas of special concern.

Table 3. Herbicides Approved For Specific Use		
Product and Type	Ingredients	Limitations / Notes
Aqua- master (equivalent to Rodeo) --herbicide in water	glyphosate, isopropylamine salt 53.8%	May damage non-target plants. Use for emergent plants in ponds, lakes, drainage canals, and areas around water or within watershed areas. Only as a last resort when other management practices are ineffective. NOTE: Equivalent to "Rodeo Emerged Aquatic Weed and Brush Herbicide," an older product. Rodeo in storage may be used under the same limitations. Note prohibition on use within buffer zone (generally 60 feet) around water bodies in red-legged frog habitat.
CMR Silicone Surfactant --adjuvant	polymethylsiloxane, nonionic	Use other alternatives pending new review of siloxanes
Eco Exempt HC --herbicide	eugenol (clove oil) 21.4%; 2-phenethylpropionate 21.4%	Do not use in enclosed areas.
EZject Selective Injection --herbicide	glyphosate, isopropylamine salt 83.5%	Tree stump injection especially where resprouting is likely, prefer mechanical methods when possible
Garlon 4 --herbicide	triclopyr, butoxyethylester 61.6%; nonpetroleumbased methylated seed oils	Use only for targeted treatments of invasive exotics via dabbing or injection.
Garlon 4 Ultra --herbicide	triclopyr, butoxyethyl ester 60.45%	Use only for targeted treatments of invasive exotics via dabbing or injection.
Milestone --herbicide	Aminopyralid, triisopropanolamine salt (5928) 40.6%	For invasive species in natural areas where other alternatives are ineffective, especially for invasive legumes and composites such as yellow star thistle and purple star thistle. <i>Listed as Tier I due to persistence but toxicity & potential exposure are very low.</i>
Roundup Pro --herbicide	glyphosate, isopropylamine salt 41%	Spot application of areas inaccessible or too dangerous for hand methods, right of ways, utility access, or fire prevention. Use for cracks in hardscape, decomposed granite and edging only as last resort. OK for renovations but must put in place weed prevention measures. Note prohibition on use within buffer zone (generally 60 feet) around water bodies in red-legged frog habitat.
Roundup ProDry --herbicide	glyphosate, ammonium salt 71.4%	Same limitations as Roundup Ultra
Sonar A.S. --herbicide in water	fluridone 41.7%	Emergent plants in ponds, lakes, drainage canals. Only as a last resort when other mgmt. practices are ineffective.
Turflon Ester	triclopyr, butoxyethyl	Targeted treatment of turf; broadcast application requires exemption.

--herbicide	ester 61.6%	Note prohibition on use within buffer zone (generally 60 feet) around water bodies in red-legged frog habitat.
Source: San Francisco, City of, 2009. <i>SF Reduced Risk Pesticide List</i> . City Department of the Environment. http://www.sfenvironment.org/ . April 13, 2009.		

Grazing

Light grazing can be an alternative mechanism to maintain open communities and eliminate invasive species, although overgrazing can result in damage including soil erosion. Overgrazing can be prevented with fencing and rotational grazing.

By itself, grazing may not be effective in completely eradicating invasive plants. When combined with other treatment control technique) severe infestations can be reduced and small infestations may be eliminated. Grazing may be particularly appropriate in areas where herbicide application is not an option such as near water or where such application would be prohibitively expensive (such as extensive and dense infestations or tough terrain), or where tough terrain makes the site inaccessible to equipment. Precautions should be made to not spread invasive seeds as animals are moved from pasture to pasture. Grazing during seed or flower production can be especially useful at damaging the invasive species without significantly impacting the desired native species. It should be noted though that some species such as cheatgrass (*Bromus tectorum*) will become unpalatable once seeding begins due to stiff awns on the flower. Sheep and goats prefer broadleaf herbs. Goats can stand on hind legs to reach higher and as well tend to graze on a wider range of weedy species. Another consideration is availability of the animals for rent or purchase and transportation to the project site. Temporary fencing would be needed to manage animals within plots.

Grazing of goats was successfully utilized for the Skagit River Restoration project in the state of Washington, by The Nature Conservancy, where the particularly tough terrain and nature of the site as a restoration project were the main concerns driving invasive species removal methods. The five acre site used 30 goats (moms and kids) rented from Akyla Farms, for a five week period in the early summer, to manage an eight-foot high bramble of blackberries that was pervasive across the project site. Planting of native species was conducted in the fall after the goats were removed and prior to the rainy season. Considering grazing in oak woodlands has reduced the amount of seedling survivorship; no grazing will be introduced to the restored oak woodland areas on the site after planting has commenced.

Mowing

Where grazing is not practical, mowing is sometimes used as a surrogate method of maintaining open grassland structure, as is practiced at nearby Edgewood Park (Friends of Edgewood Natural Preserve, 2008). Green machines and mowers can be used on a routine basis to weed around the riparian plantings, woodland, and wetland mitigation site, as needed. Mowing should take place prior to restoration activities. Follow-up mowing should be implemented for weed management in late summer after riparian plants are established. Mowing will only be employed once conditions are certain to avoid risk to the SFGS (cool temperature window) and other sensitive species. Stakes and mulch collars would help to keep the weeds and mowers away from the plants. Machinery should not be used at the site during wet conditions. When mowing is difficult

on steep, rough, and varied terrain a weed whip, weed whacker, or brush cutter may be used. Height and timing of mowing should be planned to avoid impacts to sensitive species.

Mechanical Removal

Mechanical clearing will occur on the scrub shrub area designated for grassland restoration and in the cypress areas to be cleared for oak woodland enhancement areas, using a Bron 400 or equivalent. This is a mulching device that will clear the undesired woody material including: Monterey Cypress and pine, large infestations of pampas grass, coyote brush, and poison oak.

Hand Removal

The advantages of hand pulling include low ecological impact, minimal damage to neighboring plants, and low cost for equipment or supplies. Weed wrenches, loppers, Pulaski's and other tools can be used to remove large sapling and shrubs that are too big to be pulled by hand. To minimize soil disturbance, soil should be replaced to disturbed areas. Trampled and disturbed areas can provide optimal germination sites for additional weeds, and replanting and use of seed mixes and/or erosion control mix is important. Hand clearing will be utilized on the existing coastal prairie areas as to not disturb existing vegetation and special status species.

Biological Control

Biological control (bio-control) is the use of animals, fungi, or other microbes to feed upon, parasitize, or otherwise interfere with a targeted plant species. Though this method can significantly reduce the abundance of the pest species, biocontrol control is not a viable option for the suite of target plants on the project site.

6.1.7.4 Invasive Species Descriptions

A strategy that employs multiple methods as well as monitoring and adaptive management will be the key to long-term success of the target habitat. Implementing invasive species control methods in advance of the planting schedule is recommended. The following species known to occur at the project site will be discussed individually: common velvet grass, French and Spanish broom, pampas grass, periwinkle, slender oats, and Harding grass.

French broom (*Genista monspessulana*) and Spanish broom (*Spartium junceum*)

These species have the tendency to invade grasslands, scrub and woodlands; the entire site is vulnerable to the invasion of these woody intruders. Spanish broom has a deep taproot up to 6 feet making it difficult to remove, more so, than French broom. The most effective way to control the brooms are by repeated hand pulling or burning though repeated hand pulling yielded the highest native cover (Alexander, and D'Antonio, 2003). Removal can be achieved using a combination of the following processes:

- *Mechanical:* The weed wrench is one of the most effective techniques for the complete removal of broom. The wrench locks onto the base of the stem and leverage is used to remove the entire plant. The weed wrench is effective on many trees and shrubs up to 2.5 inches in diameter even on steep slopes. This method is best when the ground is moist in the winter or spring (January –May). Some soil disturbance will occur with removal, and the bare soil may favor new seedling sprouts. Established infestations are difficult to eliminate because large, long-lived seedbanks typically accumulate. Minimizing soil

disturbances, monitoring, and repeated manual pulling of young plants when discovered can help prevent new infestations. Repeated pulling of successive generations is currently thought the most effective method, if that level of management is feasible. A flush of broom seedlings may occur directly beneath the previously canopied area after mechanical removal.

Mowing or cutting the shrubs may prevent seed production; however, resprouts will still need to be managed. Machines and tools used to remove stands may inadvertently transport seed to uninfested sites. Cutting broom shrubs to ground level at the end of the dry season can help reduce re-sprouting from the crown. Cutting plants and girdling (peeling bark down to ground surface) is an additional measure to dissuade resprouting. Planting native shrubs and trees within and around broom stands can eventually help to minimize infestations by shading (Food and Agriculture, CA Department of, 2009; and Cal-IPC, 2004).

Cutting and treating stumps with herbicide is an effective measure that reduces soil disturbance.

- *Grazing*: Intensive goat grazing has been used to control brooms. Goats are most effective in controlling regrowth following initial control strategies. Goat grazing may be difficult if trying to reestablish natives during the control process since goats will also likely browse the native plants. Goats confined to a small area can help control stands of young shrubs or young re-growth from cut shrubs (Food and Agriculture, CA Department of, 2009).
- *Chemical*: For brooms, glyphosate applied as a 2-3% v/v foliar spray has been an effective treatment. It is recommended on this site to use Triclopyr applied as a 25% basal bark application in an oil carrier after cutting older plants if they are not fully removed by a weed wrench or Pulaski. Some resprouting may occur with these mechanical treatments and follow-up pulling, or herbicide management may be necessary for future flushes of seedlings (Food and Agriculture, CA Department of, 2009). Cutting and treating stumps with herbicide is an effective measure that reduces soil disturbance.
- *Disposal*: Pulled plants that have not gone to seed can be composted on site. Plants that have gone to seed should be immediately tarped and/or bagged and removed from the site for disposal.

Pampas grass (*Cortaderia selloana* and *Cortaderia jubata*)

There are two species of pampas grass onsite, *Cortaderia selloana* and *Cortaderia jubata*. *Cortaderia selloana* (true pampas grass) can be a problem along the central and southern California coast. *Cortaderia jubata* (jubata grass or Andean pampas grass) is highly invasive throughout coastal California. Andean pampas/jubata grass colonizes bare and disturbed ground. It invades roadsides, cutbanks, dunes, coastal bluffs, rock outcrops, landslides and logged lands. Unlike Scotch broom, it does not easily colonize native grasslands. A small to medium size stand of pampas grass was observed in the southeast part of the site during fall 2009 visits. Considering the size of the population it is recommended to manually remove the plant.

- *Mechanical control:* Pulling, digging, or using a weed wrench while the plants are small is best. Small ones are easily pulled by hand when the soil is moist. Medium sized plants can be removed with a weed wrench; winter and spring are good seasons. A Pulaski or shovel is useful when a plant is too large to pull safely by hand.

The mature plants are very difficult to remove by hand. It is possible to undercut and remove one using a combination of pulaski and shovel. The easiest way is to place a choker cable around the plant's base and pull it out with a winch. The soil must be moist. Winter and spring are good seasons. For best results, the top section of the roots and the entire crown should be removed. If bagging and disposal is too difficult, designate a stockpile area and cover with a black weed mat to shade out material and allow for compost. Cutting the plumes off and placing them in bags helps to prevent further seed dispersal. The plumes cannot be cut and left on bare ground. The seeds will sprout. Depending on timing of construction activities it may be possible to remove the large pampas grass plants from the AGG site using grading equipment for the riparian areas, as this species was found along the southeast portion of the project site.

Providing an environment conducive to rapid growth of native trees produces shade adequate to exclude Pampas grass. The quality of environment for growth of natives is improved by reducing Pampas grass' competition. Over-seeding the disturbed area after removal can be an effective measure of preventing a reoccurrence of seedlings. Some resprouting may occur with these treatments and follow-up management will be necessary for future flushes of seedlings (Food and Agriculture, CA Department of, 2009).

- *Chemical:* For pampas grass, cutting and treating stumps with herbicide is an effective measure that reduces soil disturbance. Glyphosate applied as a 2% solution or eight qts/100 gallons for spot application has been an effective treatment for post emergent control (Cal-IPC). Fall application is best. For *Cortaderia jubata* it has been noted that only 20gallons per acre of glyphosate at 4% is also effective and can reduce the amount of herbicide and cost. For larger masses, it would be most effective to cut the upper plant foliage and then treat, this will also reduce the overall quantities of herbicide to be applied. This method will be applied as a last resort for this project.

Periwinkle (*Vinca major*)

Vinca spreads by arching stolon, and underground stolons, and can transplant by stem fragments carried by water. It is unknown if this plant produces viable seed (Cal-IPC). Presence on the site was noted only near a seasonal wetland/oak woodland transition in the south-central part of the site.

- *Mechanical:* Hand removal is difficult as well due to tight root systems that will easily break off and re-sprout. It is best to pull if the plants are within 1-2 inches from the soil surface, if it is moist, and if the soil is loose. Pulling the plant with a McLeod will help pull up the more dense vegetation and underground stolons. Follow up grubbing should be expected to ensure removal. For small infestations the vines can be brushcut close to

the ground and the area covered with a weed mat or cardboard to allow the plant material to decompose after a year. This is most effective if the roots are also grubbed prior to covering.

- *Grazing*: Due to a waxy surface this plant is not often browsed on and it is unknown whether grazing animals would be effective for removal.
- *Chemical*: One report states success through applying herbicide directly to the growing plant. Other practitioners recommend cutting the vegetation close to the ground in the spring when the plant is actively growing which will break up the waxy surface and improve absorption of an herbicide application. It is recommended within minutes of cutting to apply the cut stems with the selected herbicide. A test case successfully used a 2% solution of glyphosate.
Disposal: It is important to remove large cut stems from the site as these will re-sprout (IPC recommends tarping and composting the waste onsite or removing and burning) (Cal-IPC, 2004).

Harding grass (*Phalaris aquatica*)

This species grows in large clumps along the coast and can be found invading grasslands, rangelands, roadways and waterways. This plant has a deep tap root allowing it to tolerate drought. This perennial grass spreads by seed (produced May through September) but also by rhizome. Seeds last between 1-3 years. The best time to control this weed is in the dry summer months of June and July. Before this time it is too difficult to distinguish the grass and after this window the grass has already gone to seed making the herbicide ineffective (RNSP, 2008).

- *Mechanical*: Cutting around the base clump with a Pulaski and digging out all roots longer than 2 inches can be effective in controlling this species. Mulching is recommended to discourage re-sprouts. If mowing is implemented, it is recommended to be very close to the ground and to occur at least three times within the growing season to keep the plants from overtaking growth of target native species. Mowing should occur late in the growing season (spring for this species) when soil moisture is low or depleted. Cutting the grass when it is flowering will reduce the vigor of new shoots. Repeated mowing of this species can reduce the seed bank and prevent expansion and new growth, but will not eliminate the species. Disking and reseedling is a mechanical alternative to mowing. However, mowing is only a control, and does not entirely eradicate the grass.
- *Grazing*: can effectively decrease abundance of this species and it is known to be planted for forage, but can be toxic when consumed in large quantities by animals.
- *Chemical*: After mowing close to the ground, a Glyphosate (Aquamaster) herbicide can be applied to reduce the amount of effort needed for mowing or if mulching is not a desired option due to the potential of suppressing desired plants. (Cal-IPC, 2004).
- *Disposal*: bagging seed heads and disposing is thought to be the best for this species, though it can be composted in a pile on site as long as the debris doesn't contain material that went to seed.

Holcus lanatus (common velvet grass)

Also known as purple velvet grass, this is a tufted perennial grass which forms clumps and dense roots in moist areas, coastal prairies and coastal rangeland grasslands. Seedlings grow rapidly from seeds dispersed by wind and can inhibit native plant growth. This plant can produce a lot of thatch which can encourage undesired rodents. The California Plant Council rates the impact of this grass as medium (Cal-IPC).

- *Mechanical:* For small isolated patches it is possible to remove the clump of grass by hand before the seed sets. The plant can also be removed by cutting at the base with a paring knife. This is most successful during the winter rainy season from January through April. Weed whacking then scraping is another method used to control the grass before the seed set. Chopping the root crown using a blade or McLeod is another option. Cutting patches of the grass in the spring followed by mulching with 4-6 inches of onsite material has been used to suppress resprouts in small areas. Follow up treatments are necessary for all hand methods.
- *Chemical:* Is not recommended due to the grass being a facultative wetland indicator and sensitive species may inhabit the area.
- *Disposal:* The plant material should be bagged and disposed of offsite.

6.1.7.4 Native Species Plant Control

The following plants are native to California, but not to the Upper San Mateo Creek site or grassland habitats: coyote brush (*Baccharis pilularis*), Monterey cypress (*Cupressus macrocarpa*), Monterey pine (*Pinus radiata*), and poison oak (*Toxicodendron diversilobum*). Though these plants are native to California they tend to alter the nutrient and hydrology cycle when they go beyond their range into grassland and prairie habitats. A combination of techniques will yield the most successful reduction of these species. These trees and shrubs and their control methods are discussed individually below.

Coyote brush (*Baccharis pilularis*): Coyote brush is a perennial, evergreen shrub native to California where it is found in northern coastal scrub, foothill woodlands, mixed evergreen forest, and coastal stands communities. This plant typically blooms from August to September. As a result of decreased burning and grazing this plant has become intrusive to native grassland ecosystems.

- *Mechanical:* Mechanical removal of this shrub will likely be the next best method for removing the shrub from this site. Wood should be cut and dried prior to removal for burning. Small material may be composted on site. It is not recommended to chip this material do to the poisonous nature of the material and for its ability to reproduce from root fragments.
- *Chemical:* For coyote brush, glyphosate or Triclopyr applied as a basal stem application has been an effective treatment. It is recommended on this site to use Triclopyr, which

has a wider treatment window and can be applied as a 25% basal bark application in an oil carrier after cutting older plants.

Monterey cypress (*Cupressus macrocarpa*): Monterey cypress is a native tree to the Monterey Watershed in California, but not the Peninsula watershed. This tree was previously planted in the Peninsula Watershed as an ornamental landscape plant, for windbreaks, and for erosion control. This evergreen tree has the ability to change the pH in soil and has started to out-compete native flora and coastal vegetation types, including northern coastal scrub, coastal prairie, riparian scrub, woodland, and forest. This tree can create a large canopy contributing to a high cover throughout the project region and as a result has a sparse understory where it is found. The seeds can last up to 4 years in the cones before they hit the ground. A majority of the infestation is patchy in the project area, where seedlings are found next to the adult tree and cultivated stands. The cypress tree does not regrow from the stump or resprout allowing for manual and mechanical removal of this species to be sufficient. Follow-up monitoring is appropriate to ensure that new seedling emergence is removed as quickly as possible.

- *Mechanical*: Mechanical removal of this tree will likely be the most effective method. Wood may be cut, dried or chipped prior to removal for burning. Small material may be composted on site. Two trees will be girdled and left standing to provide habitat structure.
- *Manual*: For small specimens, seedlings and as a follow-up treatment of this plant, manual pulling is the best method to remove this undesired tree and reduce soil disturbance.

Monterey pine (*Pinus radiata*): Monterey pine is an evergreen tree native in only three places within California. This was once a cultivated tree in California where these source populations have escaped from areas of cultivation and now threaten other sensitive habitat types. This species was previously planted within the Peninsula Watershed where it is currently found in monotypic stands outcompeting native flora in this region. The tree has the ability to augment the pH of soils where it is found. This tree is commonly found to be associated with coast live oak woodlands, northern coastal scrub, northern coyote brush scrub, and serpentine grassland environments which are of interest to this MMP. Approximately 134 data points of this species have been mapped within the watershed by Nomad Ecology, and it is considered to be a widespread issue. This plant tends to support a native understory and caution should be taken when removing individuals from the project area. This tree does not resprout after cutting; therefore manual and mechanical removal of this species is recommended for full eradication and control of this plant. In order to achieve full eradication of this species within the project area, follow-up monitoring for seedlings is encouraged throughout the monitoring timeframe of the project.

- *Mechanical*: Mechanical removal of this tree will likely be the most effective method. Wood may be cut, dried or chipped prior to removal for burning. Small material may be composted on site.

- *Manual:* For small specimens, seedlings and as a follow-up treatment of this plant, manual pulling is the best method to remove this undesired tree and reduce soil disturbance.

Poison oak (*Toxicodendron diversilobum*): Poison oak is a native deciduous shrub to California. This plant is common in riparian environments where it can tolerate shade. It can grow as a vine and use adventitious roots for climbing nearby shrubs and trees; in more open environments such as the coastal grasslands it can take the form of a dense shrub thicket. This plant cannot be killed by cutting, as it has a strong root system and requires the termination and removal of the entire specimen to control or eradicate it from a specific location.

- *Grazing:* Intensive goat grazing has been used to control poison oak and is the main recommendation for controlling this species. Goats are most effective in controlling regrowth following initial control strategies. Goat grazing may be difficult if trying to reestablish natives during the control process since goats will also likely browse the native plants. Goats confined to a small area can help control stands of young shrubs or young re-growth from cut shrubs (Food and Agriculture, CA Department of, 2009). Grazing is also encouraged before a prescribed burn to reduce fuel and thatch.
- *Mechanical:* Mechanical removal of this shrub will likely be the next best method for removing the shrub from this site. Wood should be cut and dried prior to removal for burning. Small material may be composted on site. It is not recommended to chip this material due to the poisonous nature of the material and for its ability to reproduce from root fragments.
- *Manual:* For small specimens, seedlings and as a follow-up treatment of this plant, manual pulling is the best method to remove the undesired shrub and reduce soil disturbance.
- *Chemical:* Stump application can be effective at controlling these species during active times of growth. Immediately after cutting the shrub 2 inches above the ground surface, apply the stump with either glyphosate or triclopyr using a point brush. Basal applications are also effective at controlling this plant and this method can be utilized any time of year. Applying the chemical to 6-12 inches of the basal section is adequate coverage (DiTomaso, 2009).

Waste Material Removal

Waste material cut from some invasive species including periwinkle and pampas grass needs to be removed from the site by hand where practical, by placing waste in plastic bags or tarps, to prevent resprouting and seeding of waste material. Waste material should be burned, composted on site, or disposed of in a landfill.

Equipment Sanitation

After the initial invasive species management has taken place it is imperative that machinery be cleaned and inspected for soil and debris. Excavation and earth moving equipment can become contaminated with invasive seed stock. The machinery should be cleaned in an upland area near

the areas where invasive were removed. The equipment should be cleaned with a mobile pressure washer. The purpose is to prevent unwanted seed stock or propagules from entering unaffected areas, or areas where removal has occurred. Furthermore, this prevents unwanted herbicide (if used) from entering natural areas.

6.2 Planting Material

6.2.1 Plant Species List

A detailed planting plan, broken down by community type (including grassland, oak woodland, riparian, and seasonal wetland components, as well as a mix of host species for the Mission blue and Bay checkerspot butterflies), is presented in Table 4. The preliminary list is based on surveys at the project site and at nearby reference sites and has been updated with the most recent site information available as of May, 2010. Planting zones are identified in Figure 11.

Bare soil areas shall be covered with maximum of 4 inches of mulch, which will protect areas from erosion and reduce revegetation from non-native weedy species. Straw crimping will be the practice applied to anchor the straw mulch to the ground. Mechanically punching the straw in the soil using a shovel or spade will anchor the mulch- this method can be applied to small areas. For larger areas, a knife blade roller (crimper) can be used to anchor the mulch. On steep slopes a tackifier should be used. This will glue the straw mulch together and to the ground. The tackifier is commonly applied at 50 pounds of seed per acre and 2,000 pounds of mulch per acre. The tackifier is commonly applied at 125lb per acre, and up to 180lb per acre. Inspections are encouraged and reapplication maybe necessary to maintain the effectiveness of the straw mulch anchoring (CSQA, 2003). The tackifier should consist of a dry powder form of organic adhesive. Using water as a mixing agent, the tackifier will be mixed with seed and mulch and made into slurry with a non-toxic green dye. The dye will assist in where the tackifier has been applied.

This method should only be prepared when there is no chance of rain to occur within a 24 hour period. The seed cannot sit in the slurry for greater than 30 minutes (depending on the supplier)

6.2.2 Sources and Storage

In order to preserve the unique genetic diversity if the Peninsula watershed, plants will be purchased from nurseries and will be grown from local stock. The nurseries should be selected well in advance so that timing to collect seed and to ensure adequate quantities and sizes (for container stock) of species will be available at time of planting. Prior to site clearing and construction, it is possible for restoration contractors to collect seeds and transplants depending on the schedule. By collecting seed from sources in close proximity to the site, and within the boundaries of the watershed, there will likely be high success due to the well adapted ecotypes being utilized.

Acorn timing: Acorns should be collected from the Peninsula Watershed, in close proximity to the site, within a few weeks from when the first one falls. The ones that fall the earliest tend to be diseased or damaged and should not be collected. The acorns can be harvested from the trees by

forcing ripe acorns to the ground with long poles or hand picking them (McCreary, 2009). Larger acorns tend to perform better.

Willow cuttings can be gathered and planted on site with adherence to the directions below.

Willow (*Salix* sp.) Planting Instructions: Willow cuttings can be taken from large vigorous-growing shrubs and trees from December 15 through February 1 (when plants are dormant) prior to bud swelling. The willow-cutting source shall be within a 15-mile radius of the project area. Length of cuttings shall be three feet with a minimum $\frac{3}{4}$ inch diameter at the base and maximum of three inches. It is recommended that the bottom of the willow cuttings be cut at a 45-degree angle in order to keep track of the correct orientation of the cutting and to facilitate planting. Cuttings shall be placed in a bucket filled with water prior to planting to avoid desiccation and shall be planted within 24 hours of cutting. Willow cuttings shall be placed with the basal $\frac{2}{3}$ of the slip in the ground, with approximately 10-12 inches above the soil surface. If holes are dug or augured for the willows the soil shall be tamped around each willow slip so no air void occurs.

Table 4: Planting Plan (Approximate Quantities)														
				PLANTING ZONE		A	B	C	D	E	F	G	H	↔ (See Figure 12)
				Recommended Minimum PLS ¹⁰	Seed % of Mix	Oak Woodland		Oak/Riparian	Willow Riparian	Grassland		Seasonal Wetland		
						Establish	Enhance	Establish	Re-establish	Enhance	Re-establish	Enhance	Establish	
Adobe Gulch Grassland (Acres)				Total Area		2.2	7.00	1,150 lf	1,135 lf ^{16,19}	18.2 ac	31.5 ac	0.2 ac	NA	Notes
Butterfly Enhancement ¹¹	Planting Acreage				2.0	3.5 ¹⁴	0.5	0.5	2.1 ¹¹ / 6.5 ¹²	7.9 / 23.6	0.2	0.6		
	Salix lasiolepis ³	arroyo willow						250			10	20		
	Corylus cornuta ²	hazelnut						30						
	Rubus parviflorus ²	thimbleberry						30						
	Sambucus nigra ssp. Canadensis ²	common elderberry						30						
	Iris douglasiana ⁶	Douglas iris	58	100%			1 lb	1 lb					2 lb/ac	
	Arbutus menzeisii ²	Pacific madrone		35	55	15								
	Heteromeles arbutifolia ²	toyon		35	55	15								
	Rhamnus californica ²	California coffeeberry		35	55	15								
	Mimulus aurantiacus ²	sticky monkey flower		35	55	15								
	Quercus agrifolia ¹	coast live oak		313	547	78								
	Juncus effusus ⁴	common rush									50	125		
	Juncus patens ⁴	spreading rush						300			50	125		
	Carex barbarae ⁴	Santa Barbara sedge									100	100		
	Scirpus acutus ⁴	bulrush									50	50		
	Juncus balticus ⁴	Baltic rush									50	50		
	Eleocharis macrostachys ⁴	common spikerush									100	150		
	Eriogonum latifolium	coast buckwheat							500				D16 per 800 sq ft	
	Lomatium dasycarpum	hairy-fruited lomatium							500				2" pot per 800 sq ft	
	Lupinus albilfrons	silverleaf lupine							300				D16 per 800 sq ft	
	Lupinus formosus var. formosus	Western lupine							200				D16 per 800 sq ft	
	Castilleja densiflora	purple owl's clover	25	20%					8.4 lbs	31.48 lbs			4 lbs/ac	
	Castilleja exserta	exserted paintbrush	25	20%					8.4lbs	31.48 lbs			4 lbs/ac	
	Eschscholzia californica	California Poppy	72	5%					2.1 lbs	7.87 lbs			1 lbs/ac	
	Lasthenia californica	California goldfields	30	20%					8.4 lbs	31.48 lbs			4 lbs/ac	
	Layia platyglossa	tidy-tips	56	20%					8.4 lbs	31.48 lbs			4 lbs/ac	
	Plantago erecta	California plantain	73	15%					6.3 lbs	15.74 lbs			3 lbs/ac	
TOTAL			100%					90 lbs	149.5 lbs			total=20 lbs/ac		
Coastal Prairie	Danthonia californica ¹³	California oatgrass	UNK	20%	8 lbs		2.5 lbs		30 lbs		115		5 lbs/ac	
	Lupinus versicolor	bicolor lupine	70	5%	2 lbs		0.5 lbs		6 lbs		22		1 lbs/ac	
	Bromus carinatus ⁵	California brome	70	20%	10 lbs		1.5 lbs		30 lbs		115		5 lbs/ac	
	Elymus glaucus ^{5,7}	blue wildrye	72	15%	10 lbs		2.5 lbs		30lbs		115		5 lbs/ac	
	Nassella lepida ⁵	foothill needlegrass	54	10%	4 lbs		1 lbs		13 lbs		45		2 lbs/ac	
	Sisyrinchium bellum	blue-eyed grass			2 lbs		1 lbs		8 lbs		13		0.5 lbs/ac	
	Vulpia microstachys ⁹	three week fescue	80	10%	4 lbs		1 lbs		13 lbs		47		2 lbs/ac	
	TOTAL			100%	40 lbs		10 lbs		130 lbs	472 lbs			total=20 lbs/ac	

Erosion Control Mix	Planting Acreage				0.75 ¹⁸	0.5 ¹⁷			1.3 ¹⁷			
	<i>Bromus carinatus</i> ⁹	California brome	70	30%	14 lbs	10 lbs			26 lbs			20 lbs/ac
	<i>Elymus glaucus</i> ⁷	blue wild rye	72	30%	14 lbs	10 lbs			26 lbs			20 lbs/ac
	<i>Festuca rubra</i> ¹⁰	red fescue	80	5%	4 lbs	2.5 lbs			6.5 lbs			5 lbs/ac
	<i>Lupinus bicolor</i>	bicolor lupine	78	5%	4 lbs	2.5 lbs			6.5 lbs			5 lbs/ac
	<i>Nasella pulchra</i>	purple needlegrass	63	25%	10 lbs	7.5 lbs			19.5 lbs			15 lbs/ac
	<i>Vulpia microstachys</i> ⁹	three week fescue	80	5%	4 lbs	2.5 lbs			6.5 lbs			5 lbs/ac
	TOTAL		100%		50 + 50 lbs	35 + 35 lb			210 + 210 lbs			total=70 lbs/ac seed mix +

¹Oaks will be planted via a combination of 2-3 acorns per hole with as many as feasible nursery grown D16 size from native acorns. Spacing at 18 feet on center. Fencing and/or Romex tubing is recommended. Spacing accounts for 50% die-off, goal is for average 40 feet on center, with variability across the site.

² Upland shrubs and trees will be planted D16 size. Spacing at 30 feet on center and may be interspersed between species. Spacing allows for up to 50% die-off.

³ Willows planted on site as cuttings, 2 sets of plantings of 5 individual clustered cuttings in wetlands, and 10 feet on center spacing for riparian.

⁴ Marsh perennials planted as bare root stock, in 6 feet on center spacing, 1,200 plants/acre.

⁵ Seed quantities for grasslands are calculated based on 20 lbs pounds per acre, number provided is total pounds per species needed for each site (except where noted for erosion control mix)

⁶ Root stock (from bulbs and/or rhizomes).

⁷ Could use *E. glaucus* 'Berkley' if preferred in local setting

⁸ Erosion control seed mix is applied at rate of 70 lbs per acre of seed mix

⁹ Seed produced in CA only

¹⁰ PLS = Pure Live Seed = (percent germination x percent purity) / 100

¹¹ Species (seeds and plants) to be used as needed for listed butterfly host/nectar source in grassland enhancement

¹² Grassland enhancement assumes intermixing of butterfly enhancement mix/plantings across 25% of the area (the remainder of the area will be seeded with coastal prairie mix--see Item 11)

¹³ California oatgrass (*Danthonia californica*), 40,000 seeds per lb, seed rate of 35 lb/ac. reported in literature, used here in mix at 20 lbs per acre

¹⁴ Oak enhancement assumes removal of invasives and scrub, and enhancing approximately 50% of the area. Oak enhancement will also take place where individual existing trees are damaged, which will be replaced at a 1:1 ratio. Oaks to be installed and replaced per Footnote 1 by acorn and/or seedlings.

¹⁵ Planting of oaks will take place in areas where clumps of cypress/pine are removed along western edge of site, will replace with clumps of oaks.

¹⁶ Riparian creation--assumes approximately 1,135 lf of existing road to be converted to riparian/meander, at approximately 20 feet width=22,700 sf=0.5 acre

¹⁷ Erosion control mix proposed and estimated for gully (approx. 3.0 acre) in grassland enhancement and steep portions of site about 0.5 acre in oak enhancement area

¹⁸ Staging area = approx 0.75 acres

¹⁹ riparian creation area can be seeded with sterile barley, as needed, to stabilize area for erosion control

PLANTING NOTES:

A. The spacing between plants is between individual plants. The plant species may be mixed in some areas. Willows will be inter-planted 10 feet on center.

B. Bare soil areas for erosion control shall be covered with maximum of 4 inches of mulch which will protect area from erosion and reduce revegetation from non-native weedy species.

C. Stakes and mulch collars are recommended for planting to protect trees (willows and oaks) during establishment.

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6.2.3 Plant Sizes and Estimated Number of Installed Plants

The Planting Plan (Table 4) provides estimated quantity of each species based on acreage of area to be replaced and enhanced. Table 4 also provides recommended plant sizes and spacing, which are summarized below for reference:

- A. Oaks will be planted via a combination of acorns and nursery grown stock. Two or three (locally collected) acorns will be placed in 140 holes (15% of the container stock) for direct acorn seeding. An additional, 800 nursery grown D16 size oaks grown from propagated native acorns collected from the local watershed and will be used to supplement the direct acorn seeding. If more acorns are needed as a result of nurseries not able to find or establish viable stock additional direct seeding of acorns should be used. The total quantity of coast live oak seedlings and acorns will equal 938 planting holes/locations. Acorns are chosen to supplement container stock because of the reduced cost of acorns, and due to their ability to quickly produce a long taproot supporting drought tolerance and the reduced risks of soil pathogens from nurseries. In addition, when locally collecting the acorns for direct seeding there is assurance that the seedling is adapted to the site. Moreover, there is concern of rodent herbivory on the site and by implementing two methods for regenerating oaks on the site- there should be an increase in the success of live plants (McCreary, 2009).
- B. Using the Caltrans Landscape Architecture PS & E Guide, plant spacing and area chart are 18 ft on center equals 278.64 ft² per plant. One hundred and fifty six (156) trees will be planted per acre according to this guideline. Oaks will be installed at 18 feet on center to account for up to 50% die-off, with a goal of an average 40 feet on center, with variability/clustering across the site (Caltrans, 2008).
- C. Upland shrubs will be planted D16 size. Spacing is 30 feet on center and may be interspersed between species so that spacing between individual species may be greater than 30 feet. Spacing compensates for up to 50% die-off.
- D. Willows will be planted on site as cuttings, two sets of plantings of five individual clustered cuttings in marsh and seasonal wetlands, or 10 feet on center spacing for riparian.
- E. Marsh perennials will be planted as bare root stock, with six feet on center spacing, 1,200 plants/acre.
- F. Iris and wetland marsh and seasonal wetland will be planted by root stock (from bulbs or rhizomes).
- G. Seed quantities for grasslands are calculated based on 20 pounds per acre for seed mix, (except where noted for erosion control mix that is 70 pounds per acre mix as well as 70 pounds per acre of sterile seeds for quick coverage)

6.3 PLANT INSTALLATION METHODS

6.3.1 Hydroseeding, Broadcast Seeding, Drill Seeding

Hydroseeding may be employed in erosion control areas, areas with steep slopes and highly disturbed areas such as annual grassland if deemed appropriate. Broadcast seeding will likely be used for the supplemental butterfly mix and grassland seed mix (could also be used for erosion control mix). Drill seeding is applied using an 8-12 foot tractor towing a seed drill. This method should be used to sow seeds in the grassland restoration area, but only in bare-soil areas within

exclusion fencing where scrub has been cleared and a biological monitor has verified that no burrows potentially harboring San Francisco garter snakes are present. Drill seeding will not occur where remnant grassland openings persist. Drill seeding rates are lower than broadcast rates and have a higher percentage of germination because seeds are drilled shallowly into the soil providing better contact with the soil medium and moisture.

6.3.2 Rooted Material Planting Methods and Protections

Holes will be dug to twice the size of the root ball for all trees and shrubs except for the coast live oak seedlings. The holes will be refilled with native soil and gently tamped to reduce air pockets. An initial watering will be conducted to further eliminate air spaces and ensure adequate contact of the root surface with the soil medium.

The following protocol should be implemented when planting oak container stock (McCreary, 2009):

- **Timing:** Plant oaks during the fall after the first rainfall event has saturated soils. If planting outside of this time make sure irrigation is available.
- **Depth:** The oak seedlings will be planted at the same depth that was used in the container so no “J- rooting” will occur in the planting hole. The plant should correspond to the ground line at time of planting (McCreary, 2009).
- **Fertilizer:** A slow release, 21 gram fertilizer tablet should be placed 3-4 inches below the seedling (McCreary, 2009).
- **Soil moisture:** The holes will be refilled with native soil and gently tamped to reduce air pockets. An initial watering will be conducted to further eliminate air spaces and ensure adequate contact of the root surface with the soil medium.
- **Tools:** Though a variety of tools have been assessed for digging holes to plant oak seedlings, post-hole diggers have proven to be the desired tool. The post hole digger breaks up the soil and creates a three dimensional hole and accommodating the long tap root, and associated soil from the container.
- **Location:** Plant within micro-sites where natural protection is provided with favorable growing conditions pertaining to soil moisture, aspect, and cover.
- **Spacing:** Randomized placement to mimic natural patterns found in rangeland oak woodlands.
- **Weed control:** In early spring ensure a 4 foot weed free perimeter is maintained for the first three years after planting. If using an herbicide, glyphosate is recommended to maintain a 6 foot circle. Keeping the planting area of the oaks weed free will reduce soil moisture depletion and allow roots to penetrate downwards due to lack of competition. Remove thatch so that rodents do not have cover. **Rodent control:** Tree shelters should be placed 1” below the surface to reduce herbivory of planted material by deer and rodents.

6.3.3 Treatment of Cuttings and Other Non-Rooted Materials

The following protocol should be implemented when planting acorn seedlings (McCreary, 2009):

- **Timing:** Oaks from acorns tend to germinate quickly after fall rains and do not require soil stratification, however the acorns do not take root if the conditions of the site are too dry and the seed may desiccate. Acorns should be collected within a few weeks from when the first one falls.

- Depth: Sow acorns horizontally 1-1½" deep (no deeper than 2") into the soil surface layer to reduce loss from desiccation or depredation.
- Fertilizer: A slow release, 21 gram fertilizer tablet should be placed 3-4 inches below the acorn.
- Quantity: Install acorns (2-3 per planting hole if not pre-germinated) in the early fall or winter. If possible they will be pre-germinated and planted when the radicles are between ¼" to ½" inch long.
- Soil moisture: The holes will be refilled with native soil and gently tamped to reduce air pockets. An initial watering will be conducted to further eliminate air spaces and ensure adequate contact of the root surface with the soil medium.
- Tools: Use a pencil, screwdriver to make a hole for the radical or acorns.
- Location: Acorns should be planted within micro-sites where they are adjacent to rocks, logs, or stumps to reduce solar radiation. Often northern aspect is good for oaks as a result of soil moisture availability compared to south facing aspects.
- Spacing: Thin the best seedling after year one.
- Weed Control: In early spring ensure a 4 foot weed free perimeter is maintained for the first three years after planting. If using an herbicide, glyphosate is recommended to maintain a 6 foot circle. Keeping the planting area of the oaks weed free will reduce soil moisture depletion and allow roots to penetrate downwards due to lack of competition. Remove thatch so that rodents do not have cover.
- Rodent Control: Use a wire mesh or aluminum screen to detour rodents. Tree shelters or seedling protection tubes will be used to reduce deer browsing as they grow.

Willow cutting collection and installation are described in Section 6.2.2.

6.4 WATER SOURCES AND IRRIGATION

Dry-season irrigation is recommended for oak woodland and riparian communities for the first two years, or until planted trees, shrubs and acorns are established.

Soil should be moistened before plant installation begins. Plantings of tree, shrub, and perennial species should receive a deep watering at time of installation (approximately 10 gallons per individual plant with root ball). Plantings should be irrigated for 24 hours after initial planting if natural rainfall is not imminent. Areas seeded with seed mixes should receive a gentle watering at time of installation. Depending on amount and frequency of precipitation, supplemental watering once every approximately 10 to 15 days may be necessary in order to promote deep root growth and target species establishment. Irrigation should be continued at least until the onset of the cool weather/wet season and/or a prolonged period of early rain in the fall.

6.4.1 Irrigation Methods

Water may be provided by drip irrigation system, spraying water from a water truck (only in the western part of the project site, where access is provided by existing roads), sprinklers (not recommended on steep slopes), or a combination of methods. Water is expected to be brought in by truck and may be stored in a water tank to be placed at the western end of the site along Old Cañada Road. The water tank will be removed at the end of the irrigation period.

In general, oak plantings do not require irrigation if they are planted during the appropriate time (after fall rains saturate the soil) and a weed free circumference is maintained. However, irrigating the oaks in the first year can increase vigorous growth and plant success. If oak plantings are thought to require irrigation for the initial establishment, or on steep terrain then a irrigation basin is recommended. The irrigation should be infrequent if water is allowed to reach deep into the soil profile and is continued through to the rainy season. At most the literature expresses that 1 gallon every four weeks is adequate to establish the plant in the first year growing season (McCreary, 2009).

6.4.2 Frequency and Duration

Watering will occur at least until the onset of the cool weather/wet season and/or a prolonged period of early rain in the fall. Irrigation beyond two years will extend the monitoring period by one year for each year of additional irrigation and the monitoring period will be reset to Year 1 to ensure the plants are self sustaining, based on Regional Water Quality Control Board recommendations.

Table 5. Number of Water Events Per Month (During Dry Season)			
	1st Year	2nd Year	3rd Year
Trees, Shrubs, Perennials	2 to 3*	2 to 3	As needed
Seed Mix	2 to 3	As Needed	As needed
* = Once every 10 to 14 days			

6.5 IMPLEMENTATION SCHEDULE

The project is proposed for construction during the approved work window in year 2010. The construction window is likely restricted to the dry season to, among other things; reduce the potential for significant erosion to occur. Planting shall be done between October 15 and February 1.

Table 6. Development Timeline

Task	Start Date
1 Invasive species removal, hand clearing and grubbing	July –December 30, 2011
Pre-emergent herbicide	July -Septmeber2011
Harding grass	July – August 2011
Poison oak and Broom sp.	August – September 2011
Slender oats	August – September 2011
Pampas Grass sp. (simultaneous to grading)	September 2011
Periwinkle	December 2011
2 Vegetation clearing	August – September 2011
Monterey Cypress and Pine tree removal	August 15-September 30, 2011
Hand scrub removal	August 15-September 15, 2011
Mechanical scrub removal	September 15-September 30, 2011
3 Excavation and grading of riparian corridor	September 15-October 30, 2011

4	Seed grassland areas	September 15 – October 1, 2011
5	Seed disturbed areas with erosion control mix	September 15 – October 30, 2011 (or 2 weeks past end of grading)
6	Irrigation	September 15-November 15, 2011
7	Planting uplands and wetlands	October 1, 2011-November 15, 2011
8	Complete as-built drawings	March 15, 2012
9	1 st year Monitor grassland and wetland success	March 2012
10	1 st years Monitor woody material success	October 2012

7.0 SUCCESS CRITERIA

Performance standards for Adobe Gulch Grasslands are intended to be measurable by systematic monitoring methods.

7.1 Hydrology Criteria

H-1: During an average year of rainfall (25.28 inches), the wetlands will hold (saturated to the surface or ponding on the surface) water until at least March 31 as described in the hydrology report in Appendix B.

H-2: At the end of five years, total seasonal wetland area will be increased by at least 0.5 acres as determined by a jurisdictional delineation.

H4: At the end of five years, existing seasonal wetland depth and duration of inundation will be equal to or greater than pre-project conditions as measured in the spring of 2010, assuming equivalent precipitation during pre and post construction monitoring periods. In order to account for annual variability of rainfall, rain data will be collected from the Crystal Springs Cottage (CSC) operated by the City of San Francisco. This rain gauge is approximately 1 mile from the site. This rain data is in calibration with a stream gauge installed in January 2010. This data will be analyzed to verify the hydrology model used to design the enhancement and creation of wetlands.

H5: Channel geomorphology: For erosion, there should not be headcuts greater than 1-foot deep or 10 feet long within the channel. Also, no significant erosion or headcutting should occur at the upstream end of the grade control structures. Significant erosion includes erosion that would undermine the integrity of the grade control structure and would cause a preferential flow path under, around or through the grade control structure rather than over the structure as the design intended. Limited erosion is expected at the downstream end of the structure (scour pool).

7.2 Vegetation Criteria

V-1: For grassland communities post-planting cover shall meet the annual criteria identified in Table 7:

Table 7. Grassland Habitat Success Criteria	
Grassland	Year 1: a minimum of 50 percent absolute cover of seeded/planted grass species in hydroseeded and/or broadcast seeded areas. No more than 10percent absolute cover of target invasive plants, or no more than the percentage that occurs at the reference site, whichever higher*. No large unvegetated bare spots (greater than 25 percent) or erosional areas. Year 2: a minimum of 40 percent absolute cover of seeded/planted grass species in hydroseeded and/or broadcast seeded areas. Presence of some native and naturalized annual grassland species known from the region. No more than 10 percentabsolute cover of target invasive plants or no more than the percentage that occurs at the reference site, whichever higher. Year 3: 50 percent or greater absolute cover of grassland species (both seeded/planted grasses and typical native and naturalized annual grassland species). No more than 10 percent absolute cover of target invasive plants or no more than the percentage that occurs at the reference site, whichever higher. Year 4: 60 percent or greater absolute cover of grassland species (both seeded/planted grasses and typical native and naturalized annual grassland species), or 50 percent or greater absolute cover for serpentine grasslands. No more than 10percent absolute cover of target invasive plants or no more than the percentage that occurs at the reference site, whichever higher. Year 5: 70 percent or greater absolute cover of grassland species (both seeded/planted grasses and typical native and naturalized annual grassland species), or 50 percent or greater absolute cover for serpentine grasslands. No more than 10percent absolute cover of target invasive plants or no more than the percentage that occurs at the reference site, whichever higher. Total Acreage meeting success criteria for grassland habitat, equal to or greater than the target of 47.9 compensatory acreage.
* Target invasive species are those described in Section) 6.1.7.1	

V-2: For seasonal wetland communities post-planting cover shall meet the criteria identified in Table 8:

Table 8. Seasonal Wetland Habitat Success Criteria	
Seasonal Wetland*	Year 1: 5 percent or greater absolute cover of native seasonal wetland species. No more than 5 percent absolute cover of target invasive plants*. No large unvegetated bare spots (greater than 25 percent) or erosional areas, no evidence of oversaturation or permanent inundation. Year 2: 20 percent or greater absolute cover of native seasonal wetland species. No more than 5percent absolute cover of target invasive plants. No large unvegetated bare spots (greater than 25 percent) or erosional areas, no evidence of oversaturation or permanent inundation. Year 3: 45 percent or greater absolute cover of native seasonal wetland species. No more than 5 percent absolute cover of target invasive plants. No large unvegetated bare spots (greater than 25 percent) or erosional areas, no evidence of oversaturation or permanent inundation. Year 4: 60 percent or greater absolute cover of native seasonal wetland species. No more than 5 percent absolute cover of target invasive plants. No large unvegetated bare spots (greater than 25percent) or erosional areas, no evidence of oversaturation or permanent inundation.

	Year 5: 70 percent or greater absolute cover of native seasonal wetland species. No more than 5 percent absolute cover of target invasive plants. No large unvegetated bare spots (greater than 20 percent) or erosional areas, no evidence of oversaturation or permanent inundation. Total Acreage meeting success criteria for hydrophytic vegetation, wetland hydrology to or greater than 0.61 acres of created marsh/seasonal wetland, and 0.2 acres of enhanced marsh/seasonal wetland.
* Target invasive species are those described in Section) 6.1.7.1	

V-3: For tree-dominated communities post-planting cover shall meet the criteria identified in Table 9:

Table 9. Tree-dominated Habitat Success Criteria	
Oak Woodland	Year 1: 10 percent or greater canopy cover of typical oak woodland species. Plant survivorship of planted trees at least 75 percent. No more than 25 percent absolute cover of target invasive plants*. Year 2: 15 percent or greater canopy cover of typical oak woodland species. Plant survivorship of planted trees at least 60 percent No more than 20 percent absolute cover of target invasive plants*. Year 3: 20 percent or greater canopy cover of typical oak woodland species. Plant survivorship of planted trees at least 50 percent. No more than 15 percent absolute cover of target invasive plants*. Year 4: 20 percent or greater canopy cover of typical oak woodland species. Plant survivorship of planted trees at least 45 percent. No more than 10 percent absolute cover of target invasive plants*. Year 5: 25 percent or greater canopy cover of typical oak woodland species. Plant survivorship of planted trees at least 40 percent. No more than 10 percent absolute cover of target invasive plants*. Year 7: 30 percent or greater canopy cover of typical oak woodland. Plant survivorship of planted trees at least 35 percent. No more than 10 percent absolute cover of target invasive plants*. Year 9: 30 percent or greater canopy cover of typical oak woodland tree species. Plant survivorship of planted trees at least 35 percent. No more than 10 percent absolute cover of target invasive plants*. Year 10: 35 percent or greater canopy cover of typical oak woodland tree species. Plant survivorship of planted trees at least 30 percent. Acreage meeting success criteria equal to or greater than 2.0 acres of created oak woodland, 7.0 acres of enhanced oak woodland. No more than 10 percent absolute cover of target invasive plants*.
	*Target invasive species are those described in Section) 6.1.7.1

V-4: For riparian communities post-planting cover shall meet the criteria identified in Table 10:

Table 10. Riparian Canopy Cover Habitat Success Criteria	
Willow riparian	Year 1: 40 percent or greater absolute native woody plant canopy cover (willows and oaks) and other native woody plant recruitments. No erosional areas, no evidence of oversaturation or permanent inundation. No more than 5 percent absolute cover of target invasive plants.* Year 2: 45 percent or greater relative canopy cover of (willows and oaks) and other native woody plant. No erosional areas, no evidence of oversaturation or permanent inundation. No more than 5 percent absolute cover of target invasive plants. Year 3: 50 percent or greater relative canopy cover of (willows and oaks) and other native woody plant. No erosional areas, no evidence of oversaturation or permanent inundation. No more than 5 percent absolute cover of target invasive plants. Year 4: 55 percent or greater relative canopy cover of (willows and oaks) and other native woody plant. No erosional areas, no evidence of oversaturation or permanent inundation. No more than 5 percent absolute cover of target invasive plants. Year 5: greater than 70 percent or greater relative canopy cover of (willows and oaks) and other native woody plant. No erosional areas, no evidence of oversaturation or permanent inundation. No more than 5 percent absolute cover of target invasive plants.
Oak Riparian	Year 1: 5 percent or greater canopy cover of typical riparian tree and shrub species. Plant survivorship of planted trees at least 90 percent. No more than 5 percent absolute cover of target invasive plants. Year 2: 10 percent or greater canopy cover of typical riparian tree and shrub species. Plant survivorship of planted trees at least 85 percent. No more than 5 percent absolute cover of target invasive plants. Year 3: 15 percent or greater canopy cover of typical riparian tree and shrub species. Plant survivorship of planted trees at least 80 percent. No more than 5 percent absolute cover of target invasive plants. Year 4: 20 percent or greater canopy cover of typical riparian tree and shrub species. Plant survivorship of planted trees at least 80 percent. No more than 5 percent absolute cover of target invasive plants. Year 5: 25 percent or greater canopy cover of typical riparian tree and shrub species. Plant survivorship of planted trees at least 75 percent. No more than 5 percent absolute cover of target invasive plants. Year 7: 35 percent or greater canopy cover of typical riparian tree and shrub species. Plant survivorship of planted trees at least 75 percent. No more than 5 percent absolute cover of target invasive plants. Year 9: 45 percent or greater canopy cover of typical riparian tree and shrub species. Plant survivorship of planted trees at least 70 percent. No more than 5 percent absolute cover of target invasive plants. Year 10: 50 percent or greater canopy cover of typical riparian tree and shrub species. Plant survivorship of planted trees and shrubs at least 65 percent. No more than 5 percent absolute cover of target invasive plants.

	*Target invasive species are those described in Section) 6.1.7.1
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8.0 MONITORING

8.1 Hydrology and Soils Monitoring Methods

Monitoring of hydrology will be completed through physical survey (topographic measurement for riparian channel and seasonal wetlands, cross sections and longitudinal profiles for creeks) of several critical locations including where water flows into the site, where the stream bifurcates, the rim of the wetland edges, and where water flows off of the site. Physical survey of the riparian channel will be completed annually for the first five years, and then biannually through year 10. If there are changes in elevations at these locations as a result of storm damage, fallen trees, or excessive accumulation of vegetation, corrective actions will be evaluated and, if determined appropriate, a solution will be proposed to the regulatory agencies. Physical survey of the seasonal wetlands will consist of surveying the limit of inundation within 10 days of a January storm event during a normal (or wetter) precipitation year. Precipitation and weather conditions will be documented. In the event of prolonged drought, extension of the monitoring period or other appropriate adaptive management may be proposed.

Methods for quantifying the geomorphic and hydrologic function of the wetlands will include:

- 1) Installing a staff gage within the wetland for the purpose of measuring depth and duration of inundation as well as sediment accumulation within the wetland. During the rainy season, the staff gages shall be monitored at a minimum of one time per month and after storm events that exceed 2-inches in depth according to the Crystal Springs Cottage (CSC) rain gage operated by SFPUC. After the rainy season, the draw down time shall be monitored by observing the inundation depth on a weekly basis for the first year and every 1 to 3 weeks for subsequent years based on the calculated draw down time. The frequency of monitoring the drawdown after the first year is based on calculating the drawdown from the first year and ensuring that measurements are taken when the wetland depth of inundation at the maximum depth, half the maximum depth and right before the wetland is dry. The Technical Standard for Wetland Hydrology was met if wetland hydrology occurred in at least 50 percent of years (i.e., ≥ 5 years in 10) (EPA, 2005).
- 2) Performing a topographic survey based on NAVD 88 and the horizontal coordinates are based on NAD83 (2007) LEICA RTK-MAX Northern California Network. The survey must tie into the existing topographic data of the site. Two perpendicular transects at minimum shall be taken within each wetland. The surveys should occur at minimum every 3 years or when significant erosion or accretion has occurred in the wetland. The provided survey data points shall be in .01' accuracy.

Methods for quantifying the geomorphic and hydrologic function of the creek will include:

- 1) installing a pressure transducer within the creek and developing a flow rating curve based on the as-built channel geometry and flow depth to closest 0.1';

- 2) installing one (1) sediment staff gage per grade change location (10 total) that will measure the depth/height of erosion/accretion within the channel to the closest 0.1'. This amount of erosion/accretion will be converted into a volume of mass that has been transported;
- 3) performing a topographic survey based on NAVD 88 and the horizontal coordinates are based on NAD83 (2007) LEICA RTK-MAX Northern California Network. The survey must tie into the existing topographic data of the site. The survey shall include a thalweg longitudinal section with a minimum reading every 50 feet and as well as the top and bottom of the grade control structures. Cross Sectional surveys shall occur every 50 feet at minimum and at locations identified as possible areas of erosion or accretion. The surveys should occur at minimum every 3 years or when significant erosion or accretion has occurred in the creek. The provided survey data points shall be in .01' accuracy.

Soils will be evaluated annually in each of the wetland cells on the AGG site. One hole per wetland cell will be evaluated to a depth of 15 inches.

8.2 Vegetation Monitoring Methods

8.2.1 Permanent Photo Documentation Points

Permanent photo documentation points will be established within the project area prior to construction. A minimum of 2 photo documentation points per project area will be established to document site conditions. The location of the photo documentation site will be GPS'd to facilitate relocation and a GIS map of the location created as part of the first monitoring report. The photo documentation points should include landscape features that are unlikely to change over several years (buildings, other structures, and landscape features such as peaks, rock outcrops, large trees, etc.) so that repeat photos will be easy to position. The placement of a permanent T-post or metal fence post marking the photo points will improve consistency between years (State Water Resources Control Board 2010).

Photos will be taken from these photo documentation points at the same camera angle each monitoring year, using a north, south, east, west compass bearing axis at the selected photo points, as appropriate to illustrate site conditions.

Photographs will be taken from approximately 5 ft in height, with exact height recorded using a standardized tripod or rod to ensure consistency of height from year to year.

In addition to the permanent photo stations, photographs will also be taken from the origin of each vegetation monitoring transect looking north, south, east, and west. In Years 5 and 10, vegetation cover will be assessed using aerial photos if available to supplement other data collection methods.

8.2.2 Vegetation Monitoring

Vegetation monitoring will be performed using a statistically robust method known as power analysis to assess tree survivorship and percent cover of native and invasive perennial forbs, grasses, and shrubs. Power analysis would measure percent survivorship to within a margin of

error of 10% at the 95% confidence interval (i.e., assesses percent survivorship to within +/- 10% of the true value, with a 95% likelihood of covering the true value in that range). The proposed power analysis method includes:

- Development of a monitoring protocol describing data collection techniques;
- Sub-sampling across different planting areas, sites and habitats; and

The proposed method would minimize the data collection effort while meeting requirements for statistical rigor.

Vegetation monitoring will be conducted during Years 1-5 for hydroseeded grassland, and planted or established wetland, and willow riparian communities and in Years 1-5, 7, 9 and 10 for tree dominated communities. The point-line intercept method will be used to estimate total vegetative cover, native cover, hydrophytic cover, and non-native invasive cover. A count of planted hardwood trees within 100 m² plots will be used to estimate tree survival. These methods will be used to determine whether mitigation areas are meeting set success criteria for vegetative cover.

Power analysis. An *a priori* power analysis will be used to determine the monitoring effort required for the statistical analysis. The design of the statistical analysis influences the power analysis, including: specific question to be answered and related statistical parameters; in this case, the allowable margins of error and confidence intervals. We define the specific question to be addressed as follows:

Is the true value of the percent cover less than or equal to the percent cover requirement?

The allowable certainty for percent cover will be a margin of error of +/- 10% at the 95% confidence interval. The confidence interval is the probability that the true value would be encapsulated in the margin of error around the reported percentage; the lower the confidence interval, the smaller the margin of error. Margin of error (ME), confidence interval and required number of sampling points (n) are related by the following equation for the 95 % confidence interval:

$$ME = 0.98/\sqrt{n}$$

The number of sampling points required to evaluate percent cover will be calculated using this equation. However, the following factors will be considered in estimating the number of sampling plots to estimate survivorship:

- The specific monitoring targets (e.g., such as whether survival of some planted species can be pooled resulting in fewer sampling points or must be examined separately by species),
- The number of trees to be planted and number of different planting areas.

Monitoring Protocol and Analysis for Estimating Hardwood Tree Survival. Data collection for survivorship for planted hardwood trees (primarily oaks) will require a biologist to determine if a given plant is alive or dead at a given number of flagged planting sites in an area (sampling plot).

Sampling plots will be used to conduct survivorship surveys. These plots will be randomly established each year based on a grid overlay of the entire mitigation area. Using GIS, a 10-meter by 10-meter grid will be overlaid on all mitigation areas. Each vertex of that grid will be labeled with a number. Using a random number generator, vertices will be selected to serve as the center of square sampling plots and transects. Once the vertices have been selected, locations will be identified in the field using a GPS device. Biologists will navigate to the coordinates specified by the GPS and establish a center point. From this center point, 2 10-meter transect tapes will be extended, 5 meters in each cardinal direction; the center point will be located at the 5-meter mark for both cross-transects. In each 10 meter by 10 meter plot, each live tree will be counted. In addition, observations regarding tree health (e.g., premature leaf loss, evidence of dieback shoots, severe insect infestation) will be noted, particularly when poor health is an apparent indicator of imminent mortality.

The number of sampling plots depends on the vegetation community, final number of hardwood trees to be planted, number and size of planting areas, data collection method and spacing of plantings. Data must be collected at 3 or more sampling plots to allow for statistical analysis. Since some habitat types (e.g., riparian habitats) are being established/reestablished or rehabilitated in very narrow bands, it is possible that the 100m² plots, will not fall entirely within a single habitat type. If this occurs the plots can be shifted such so the entire plot is in a single habitat type.

A t-test will be used to evaluate whether or not percent survivorship is less than or equal to the interim or final success criteria.

Survivorship trends will be analyzed after collecting 3 years of data, the minimum required to plot a line. Percent survival mean and 95% confidence interval will be plotted against time along with the minimum allowable percent survival. An analysis of trends in survivorship will evaluate if the survivorship decline rate over time is significantly different than zero. Without replanting or recruitment, survivorship will decline over time, likely modeled as exponential, ideally, flattening over time.

Monitoring Protocol and Analysis for Estimating Vegetative Cover. Point-line intercept surveys will be used to estimate absolute vegetative cover, native cover, and hydrophytic cover in grasslands, wetlands, and willow riparian habitats. Point-line intercept surveys will also be used to estimate non-native invasive species cover in all habitats. The number of sampling points would be determined using the power analysis method above¹.

Data will be collected along randomly located transects at points established by placing a 2-meter metal rod vertically (perpendicular to the ground) at defined intervals (1 or 5 meters) along a transect tape. The plant species touching the rod within each height category (low, medium, and high) will be recorded. Plant species that touch the rod in more than one height category will be recorded in each height category. The 2 smallest vegetation height categories, Low (0.0 meter to 0.5 meter) and Medium (0.5 meter to 2 meters), are captured by the height of the rod (2 meters

¹ Note that a margin of error will increase the uncertainty around the percent cover of invasive species. The threshold for invasive species 5% cover, however, a value of 4% could represent a value of 0 to 9% cover of invasive species (at the 95% confidence interval). Reducing the margin of error requires increasing the sampling effort, and margins of error within 1% would require prohibitively intensive sampling efforts.

tall). The High category (over 2 meters) will be estimated using eyesight. In addition to vegetative cover, each point where there is no vegetation, bare ground will be noted.

A t-test will be used to evaluate whether or not percent cover is less than or equal to the interim or final success criteria. Trend analysis may be more informative than examining threshold exceedance because invasive species percent cover increases often are predictive of long-term ecological composition. Trend analysis would be conducted as described for tree survivorship with the caveat that annual climatic variation may influence the percent cover.

Non-native Invasive Plant Monitoring. During spring or early summer of Years 1-5, and for tree dominated communities in Years 7, 9 and 10, non-native invasive plant cover will be calculated from the point intercept data collected from all sites, as described above. In addition to this monitoring, areas with greater than 5 percent cover of target non-native species will be mapped using GPS as long as areas are safely accessible. Maintenance activities to control non-native invasive species will be targeted in these areas. Each year the acreage of mapped highly invasive species will be compared.

A spring inspection in subsequent years comparing mapped non-native invasive cover from the prior year will be conducted to determine if a non-native invasive species population has spread or a new species has invaded. In either scenario, maintenance activities may be required.

8.2.3 General Site Assessments

Qualitative data will also be collected each year of monitoring for the purpose of informing management. These general site assessments are intended to assess the overall functioning of the site as a whole, and also to help identify localized or low-level trends such as new invasive species formations, localized changes in species abundance, and other changes that might be important to address through remedial management actions.

The following data will be collected during the site assessment:

- Mortality (presence/absence) of planted trees.
- Species richness. This general site data will be used for calibrating similar data taken at transects, but is not intended for comparison with success criteria. Data will also help to evaluate whether invasive or non-native species are out-competing native plants, and whether more active management might be required.
- A visual assessment of cover in planted and hydroseeded areas, invasive species over the entire site, and related observations of vegetation and habitat condition.
- Other site characteristics, including patterns of plant die-offs, erosion, hydrological issues, trespass, herbivory or grazing pressure, or other land use issues. This information is intended for use in recommending management actions as necessary.

Table 1. Qualitative Score for Assessing the Health and Vigor of Planted Stock

SCORE	DESCRIPTION OF SCORE
Excellent	No evidence of stress; minor pest or pathogen damage may be present. No chlorotic leaves, no or very minor herbivory (browse). Evidence of new growth, flowering, seed set on majority (greater than 75 %) of plants observed.
Good	Some evidence of stress. Pest or pathogen damage present, few chlorotic leaves (> 5%), minor evidence of herbivory (browse). Evidence of new growth, flowering, seed set on most (greater than 50%) of plants observed.
Fair	Moderate level of stress; high levels of pest or pathogen damage, some chlorotic leaves (> 10%), some herbivory damage (few snapped leaves, stems, wear marks etc.). Evidence of new growth, flowering, seed set on some (less than 50%) of plants observed.
Poor	High level of stress; high levels of pest or pathogen damage, many chlorotic leaves (> 30%), severe herbivory damage (massive forage damage, main stems/leaves stripped etc.). No evidence of new growth, flowering, or seed set, or only a few plants (less than 25%) with these characteristics.

8.2.4 General Wildlife Use

A general wildlife use assessment will be conducted once during the monitoring period to document common wildlife, songbird, and raptor use of the site. Data are intended to help assess overall site functioning and not as a performance measure. Annual monitoring will be conducted for the San Francisco garter snake and the California red legged frog special status species. Day and night surveys will occur 2-4 times per year and is to be performed by a qualified biologist.

- Surveys will be conducted between March- June
- Survey will be conducted at the deeper wetlands
- Document habitat conditions
- Document occurrence or absence of prey (for snakes)
- Depth of pond (Dmax)
- Water availability to support the CRLF
- Water temperature (near surface and at Dmax)
- Percent cover of emergent vegetation
- Occurrence of SFGS & CRLF using visual, auditory, dipnet, egg masses, and larval surveys
- Occurrence of additional amphibian species (adults, juveniles and larvae)
- Occurrence of predators including snakes, birds, bullfrogs, and fish (native predators at low density are expected and acceptable within restored habitat)

8.3 Monitoring Schedule

Generally, grassland and wetland communities will be monitored from late March through May, and woodland or riparian communities in late September or early October. Some flexibility to account for annual variation in weather conditions is acceptable.

Monitoring of vegetation will be completed during the performance period as described below. After the performance period (typically five years for understory and 10 years for oaks), the site

will be inspected for general parameters including observations of invasive non-native plants or trees, signs of erosion or vandalism, and vitality of woody trees surviving the performance period as part of the site's long-term management.

Table 13: Annual Monitoring Schedule for Adobe Gulch Grassland Site

Task	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
<i>Permanent Photo-monitoring</i>			*	*								
<i>Hydrology Monitoring</i>	*		*			*		*				
<i>Vegetation Monitoring</i>			*	*								
<i>Invasive Species Monitoring</i>			*		*		*			*		
<i>Wildlife Monitoring</i> *			*	*	*	*						
<i>Monitoring report</i>												*
*Includes, but not limited to, target species (aquatic and MB butterfly); * only needed if occurrence was not recorded for the CRLF												

9.0 MAINTENANCE DURING MONITORING PERIOD

9.1 Processes

The community types present at Adobe Gulch Grasslands provide habitat for sensitive as well as more common species. Created and enhanced habitats have been designed to be as self-sustaining as possible. However, natural ecosystems are dynamic and subject to change over time. This is especially true in modern fragmented urban preserves, where the vast landscapes and ecological processes which once maintained a habitat mosaic may have been partially or completely disrupted. Natural processes include flood and drought, fog, fire, wind, disturbance by burrowing animals, and grazing.

As a result of human-induced change, management is usually required to maintain preserves and prevent gradual degradation. In the short term, management will likely be necessary to minimize resprouting of aggressive native species such as coyote brush and poison oak in grassland areas. The following discussion identifies approaches to longer term maintenance after the end of the construction and planting period.

9.2 Inspection Activities and Frequencies

The following inspections will be generally performed on an annual basis at the time of mitigation monitoring unless a different interval is specified below. Field notes will document whether conditions are normal or abnormal, and the annual monitoring report will recommend remedial actions to address any significant issues, as deemed necessary. The annual monitoring should note whether within each habitat type, the following conditions are observed:

1. Is erosion control in place and functioning properly?

2. Are planting areas exhibiting excessive water or drought stress (too much or too little water as evidenced by leaf wilt, leaf drop, plant die off, etc.), as described in Table 11?
3. Is there any presence of new or reestablished populations of invasive or undesirable plants? Pioneer populations of invasive species (previously unidentified at the site, such as fennel, pampas grass, etc.) should be treated immediately upon detection. Existing invasive plant populations (as listed in Section 6), or others, are to be managed under an adaptive management plan if reestablishment or continued predominance is detected. Invasives monitoring would be conducted monthly during the growing season.
4. Is there a distinctive pattern of plant die off (i.e., all species of a single plant or a cluster of plants within a small area)?

9.3 Remedial Actions (Adaptive Management)

While initial efforts are important, living systems require ongoing maintenance and management. We recommend an adaptive management strategy for maintaining and managing the site.

Adaptive management is a tool used to cope with the inherent changes and instability fundamental to natural resources and the ecological processes that encompass them. It is a process derived from a collection of practical methods based in research and monitoring. As a philosophy, it holds that conservation and restoration programs should be designed in ways that accumulate knowledge as quickly and accurately as possible so that the management plan can be adapted promptly to better management efforts. This approach allows managers to learn by experience within site specific environments and apply lessons learned to remedy deficiencies using a controlled and scientific approach.

Monitoring and maintenance will respond with adaptive management procedures, recommended on a case-by-case basis, to address any issues identified at the site. Remedial actions could include one or more of the following activities (not exclusive) if success criteria are not met:

1. Weeding around planting sites to reduce competition from non-native grasses and forbs;
2. Supplemental watering;
3. Additional erosion control;
4. Additional invasive plant control;
5. Supplemental replacement plantings (may be in-kind, or if a particular species is not doing well at the site, a suitable replacement species can be supplemented for original plant species);
6. Hydrologic modification or minor regrading

9.3.1 Initiating Procedures

Standards for when to implement remediation will be if the percent cover in any monitoring year (averaged over sample plots) is 15percent below the target level described under “Annual Success Criteria”, or if additional final criteria are not met. The hydrologic triggers that will dictate remedial actions are water quantity, erosion, and sedimentation. If an annual performance criterion is not met, a report shall be prepared analyzing the cause of failure and, if necessary, proposing remedial action for agency approval.

9.3.2 Replanting

Replanting would be recommended if it is deemed that no other procedure could be employed to restore the target habitat to meet monitoring criteria if there is a lack of survival from targeted planting efforts

- Replanting may be deemed appropriate during the 6 month installation warranty period to replace dead plants. Plants should be replaced during the next rainy season. This should be considered throughout the monitoring period, considering the 6 month window may not include potential casualties during the dry season.
- Replanting will also be incorporated if success criteria are not being met to remedy the loss of live plant stems. There is potential to change the plant palette if a lack of diversity has occurred.
- If a target species has poor success throughout the site it may be replaced with a new species of botanical significance to the restoration habitats.

There is potential to increase the amount of special status plant species in a follow-up planting plan for year two. Currently, viable plant stock is not available and seeds will need to be collected this fall to be propagated if they are desired to be planted in year 2 after construction has been completed.

The Adobe site has moderate potential for the following special status plant species to occur once the site is restored: Franciscan onion (*Allium peninsulare* var. *franciscanum*), San Francisco collinsia (*Collinsia multicolor*), Western leatherwood (*Dirca occidentalis*), and Choris's popcorn flower (*Plagiobothrys chorisianus* var. *chorisianus*) and bristly sedge (*Carex comosa*).

The nurseries should be selected well in advance so that adequate quantities and sizes of species will be available at time of planting.

9.3.3 Regrading

Regrading could be recommended if it is deemed that no other procedure could be employed to restore the target habitat to meet monitoring criteria.

9.3.4 Hydrologic Modification

Hydrologic modification by regrading could be recommended if it is deemed that no other procedure could be employed to restore the target habitat to meet monitoring criteria.

9.4 Invasive Species Control

9.4.1 Predators

Deer and rodents are the main concern for browsing on the plantings, particularly the oaks and willows. Stakes and mulch collars are recommended for planting to protect trees (willows and oaks) during establishment. Six-foot high metal deer fencing attached to metal posts could be used

to protect the trees during establishment. Mowing in the fall should reduce the amount of rodents as their refugia cover will be lost. This will also reduce undesired seed set of naturalized and non-native weeds. Tree shelters, wire mesh or aluminum screen, or subterranean root cages should be placed one foot below the surface to reduce herbivory of planted material by rodents. Generally, tree shelters should be opaque, with high light transmission and good ventilation for best results. It should be noted that the lighter color tree shelters detour voles and mice, also increasing survival of newly planted stock.

Predator control actions will be evaluated via monitoring and reviewed for efficacy. In the event that predator control fails to meet success criteria, contingency measures include:

- Draining wetlands to ensure the lifecycle for the bullfrog will not be met; if they are not self performing to dry out as intended they will be redesigned.
- If rodents are severely impacting the success criteria of planted oak material there may be a need to increase the timing of occurrence of removing the dense ground cover adjacent to the planted material. If deemed appropriate it may necessary to replant rooted specimens with a different tree protection measures.

9.4.2 *Vegetation*

Section 6 presents weedy/non-native and invasive species that are known to occur at the site, as well as management strategies to be employed to eliminate these species, as feasible.

Mowers can be used to weed around the riparian plantings, woodland, and wetland mitigation site, as needed and with procedures in place to prevent harm to sensitive animal species. The weed management should be done at least once a year in late summer until riparian plants are established. Stakes and mulch collars will help to keep the weeds and mowers away from the plants. Oaks require a 4 foot weed free circle to be maintained for the first 2-3 years after planting. This can be done with weed whackers, or by mowing for efficiency and cost reasons. If using weed whackers or mowers it should be timed to occur in the early or mid summer after annuals have desiccate and turn brown. Hand removal of weeds using a hoe to scrape the surface is adequate if this is done in the spring, there will be are reduction of annual grass seeds in the soil (McCreary, 2009). Reducing non-native annuals and invasive plants should occur throughout the year if needed.

Machinery should not be used at the site during wet conditions. Invasive species control will likely require repeated effort for at least several years and possibly throughout the monitoring period. Specific needs will be identified based on each year of monitoring, and documented in annual reports. Appropriate control methods will be utilized depending on the species, the abundance and distribution of the species, and the location within the site and relative to wetlands or other sensitive resources. Adaptive management is emphasized wherein various strategies will be employed, as presented in Section 6.0 depending on site-specific conditions and invasive species issues at the time of management/maintenance activity. Tu et al. (2001) and other publications on invasive species control may be referenced when identifying appropriate methods for use within a habitat enhancement site.

Adaptive management can include non-chemical applications where the area around the trees can be mulched, or use of a black shade mat to increase survivorship of new woody stem plantings until trees are approximately 3 feet tall. Periodic grazing in the spring and late summer, mowing and propane torch flaming for residual brooms, poison oaks, and coyote brush can be implemented as post activity management techniques.

Post emergent application should still be considered after plant installations if deemed appropriate.

Prescribed burn is an effective method that would be evaluated in the future as the need arises.

9.4.3 Predators

Predator control actions will be evaluated via monitoring and reviewed for efficacy. In the event that predator control fails to meet success criteria, contingency measures include:

- Draining wetlands to ensure the lifecycle for the bullfrog will not be met; if they are not self performing to dry out as intended they will be redesigned.
- If rodents are severely impacting the success criteria of planted grassland or wetland plant stock for target habitats, there may be a need to increase the timing of occurrence to remove the dense ground cover adjacent to the planted material. If deemed appropriate it may necessary to replant rooted specimens with different protection measures.

9.5 Maintenance Schedule

Maintenance will be conducted annually, during the dry season unless another time of year is more appropriate to avoid disturbance to sensitive species, habitats, or resources. Weed management (such as with a mower) should be done seasonally, throughout the year until riparian and woodland plants are established. If timing of maintenance needs to be modified for certain items, the rationale for the decision will be documented in annual reports.

The schedule for maintenance during the monitoring period is shown in Table 14.

Table 14. Schedule for Maintenance During the Monitoring Period

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.
Revegetation Inspection and Maintenance			I	I			I					M
Invasive Plant Inspection and Maintenance	I,M		I,M	I,M	I,M		I,M		I,M	I,M		
Predator Inspection and Maintenance *				I		I			I			

I = Inspection, M = Maintenance

*Predators (bullfrogs, fish) are not expected to be a significant issue in the seasonal wetlands of the Adobe Gulch Grassland site. Management will occur only if inspections identify an issue.

10.0 MONITORING REPORTS

10.1 As-Builts

At completion of site grading and planting, as-built drawings will be prepared and provided to appropriate agencies. Drawings will show, at a minimum, post-grading surface contours, typical cross-sections, and limits of each habitat or planting zone. The Water Board shall be notified that mitigation construction and planting has been completed within 72 hours of concluding these activities.

10.2 Annual Reports

Annual reports of monitoring results will be submitted to the U.S. Army Corps of Engineers, San Francisco District, and the Bay Area Regional Water Quality Control Board, California Department of Fish and Game, and U.S. Fish and Wildlife Service. Once the planting efforts are completed, the Water Quality Control Board would like to be contacted within five (5) days. The reports will assess attainment of yearly target criteria and progress toward final success criteria. If final success criteria are met early, then a request for early completion of permit requirements will be made. Photographs of restoration areas shall be included in annual reports, as necessary, to document site conditions.

10.3 Due Dates

As-builts will be provided within 120 days after the completion of construction and planting activities. The Bay Area Regional Water Quality Control Board would like to be notified within 5 days after revegetation activities are completed. The first annual report shall be delivered by December 31 of the year following the first growing season after planting, with a report provided by December 31 of each subsequent year until the end of the 5-year monitoring period.

11.0 CONTINGENCY MEASURES

11.1 Initiating Procedures

If an annual performance criterion (averaged over sample plots) is not met for any year, or if final criteria are not met, a report shall be prepared analyzing the cause of failure and, if necessary, proposing remedial action for approval by the agencies. Potential remedial actions include but are not limited to replanting, modifying management strategies or methods, providing additional offsite mitigation or extending the monitoring period.

11.2 Contingency Funding Mechanism

SFPUC is responsible for funding any adaptive management or additional measures which it determines are necessary and with which the appropriate agencies concur. SFPUC will provide the agencies with a financial assurance memorandum of understanding as a standalone document.

12.0 COMPLETION OF MITIGATION RESPONSIBILITIES

12.1 Notification

When performance criteria have been met, the applicant will notify the San Francisco District of the U.S. Army Corps of Engineers, the U.S. Environmental Protection Agency, the U.S. Fish and Wildlife Service, the California Department of Fish and Game, and the Regional Water Quality Control Board. Documentation will be provided within the accompanying annual report.

12.2 Agency Confirmation

Upon notification of completion the agencies identified above may concur based on written documentation or, at their discretion, may request a site visit to observe the completed project.

13.0 LONG TERM MANAGEMENT

Long-term management will be required at the created, enhance, or restored wetlands, riparian and grassland habitats. A Long Term Management Plan for all of the Peninsula HRP sites, including the sites described in this MMP will be prepared and submitted for agency review by December 2010. This Plan will provide information concerning ongoing management of these sites by SFPUC after the final success criteria described herein have been met. The Long Term Management Plan will define the goals and objectives for each habitat type and prescribe management actions to meet them. Activities that will be addressed in the Plan will include but not be limited to: invasive plant management (including native as well as non-native plants), invasive predator control, erosion and sedimentation, infrastructure management, and grazing. Monitoring, contingency measures, and schedules associated with these activities will also be addressed in the Plan. The Plan will also be of sufficient detail to feed into the PAR analysis and the development of the endowment for the conservation easement.

14.0 SITE PROTECTION

The Adobe Gulch Grasslands site is well within the larger Peninsula holdings, which are protected by perimeter fencing and gates. Although located within the interior of the site and remote from major roadways, the site is bordered by a narrow paved roadway. Signs will be installed at site access points to educate authorized visitors about the sensitive nature of the habitat. Watershed keepers will patrol the access road and report any damage or other issue.

14.0 LITERATURE CITED

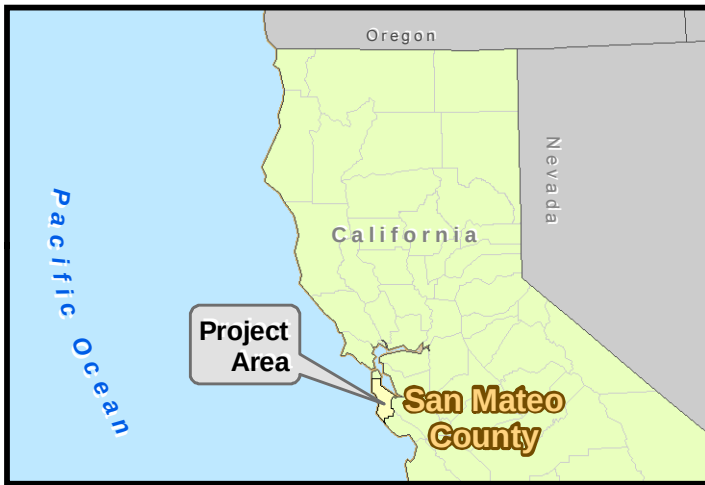
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0 2,250 4,500 9,000 Feet

1 inch = 4,500 feet



Adobe Gulch



City Boundaries



Primary Highway



Secondary Highway

Roads on SFPUC land

Paved road

Unpaved road

Figure 1
Adobe Gulch
Grassland Restoration
Vicinity Map

Projection & Coordinate System:
California State Plane NAD 83 Ft Zone 3
Lambert Conformal Conic
GCS North American 1983
Datum: D North American 1983



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Date
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0 250 500 1000 Ft

1 inch = 500 feet



Intermittent stream



Offsite-not delineated



Seasonal wetland



Willow riparian



Adobe Gulch
Project Area

Roads on SFPUC land



Paved road



Unpaved road

Figure 2
Adobe Gulch
Grassland Restoration
Jurisdictional Wetland
Delineation

Projection & Coordinate System:
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Upper Crystal
Springs Reservoir

Old Canada Rd

Old Canada Rd - Adobe Gulch

Old Canada Rd

0 225 450 900 Ft
1 inch = 450 feet



Adobe Gulch
Project Area



Contours - Index (10 ft)



Contours (2 Ft)

Roads on SFPUC land

Paved road

Unpaved road

Figure 3
Adobe Gulch
Grassland Restoration
Topography

Projection & Coordinate System:
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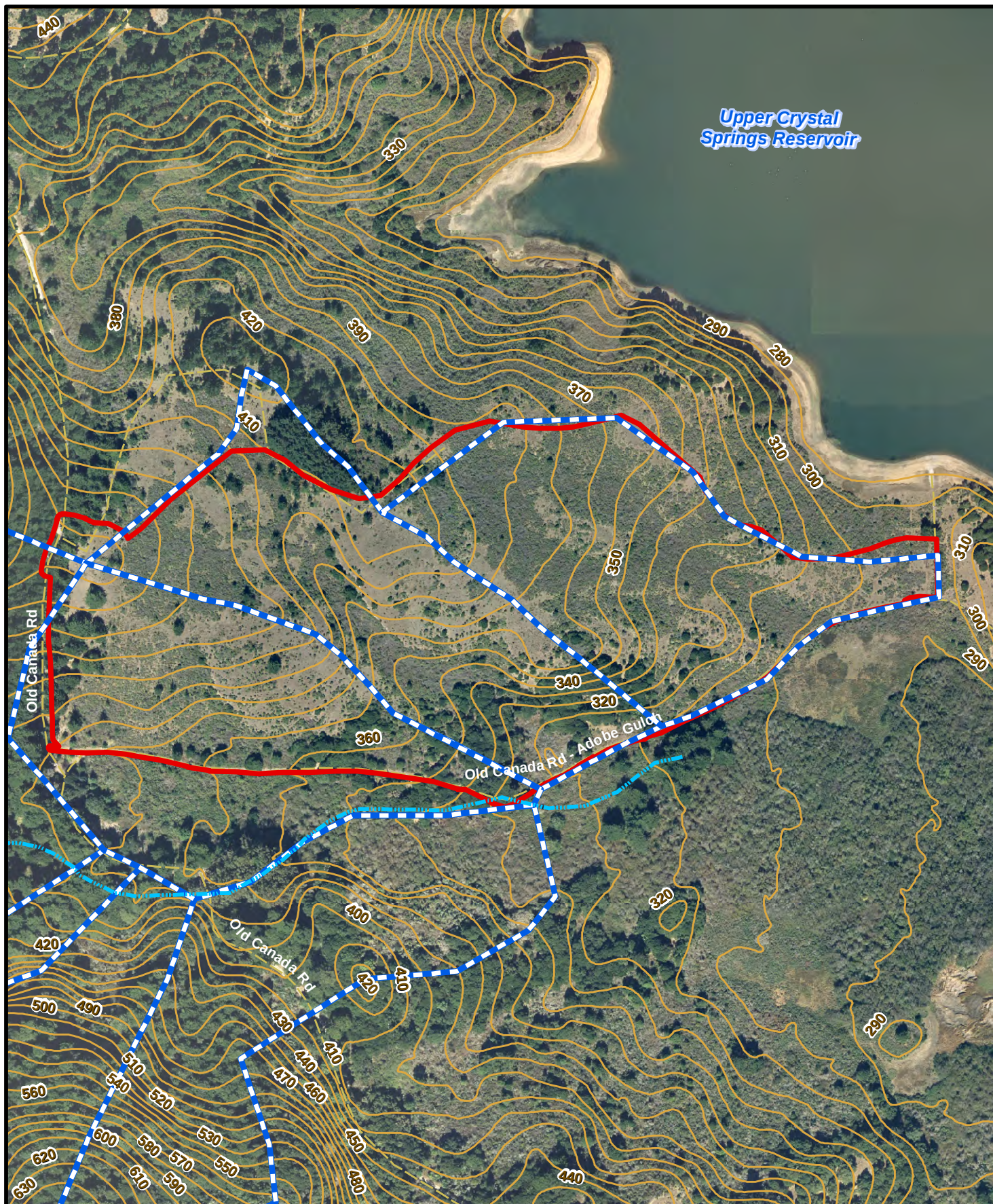
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0 225 450 900 Feet
1 inch = 450 feet



Adobe Gulch
Project Area



Watershed Boundaries

Hydrology - lines; source: SFPUC



Intermittent Stream



Contours - Index (10 ft)

Figure 4
Adobe Gulch
Grassland Restoration
Hydrologic Basemap

Projection & Coordinate System:
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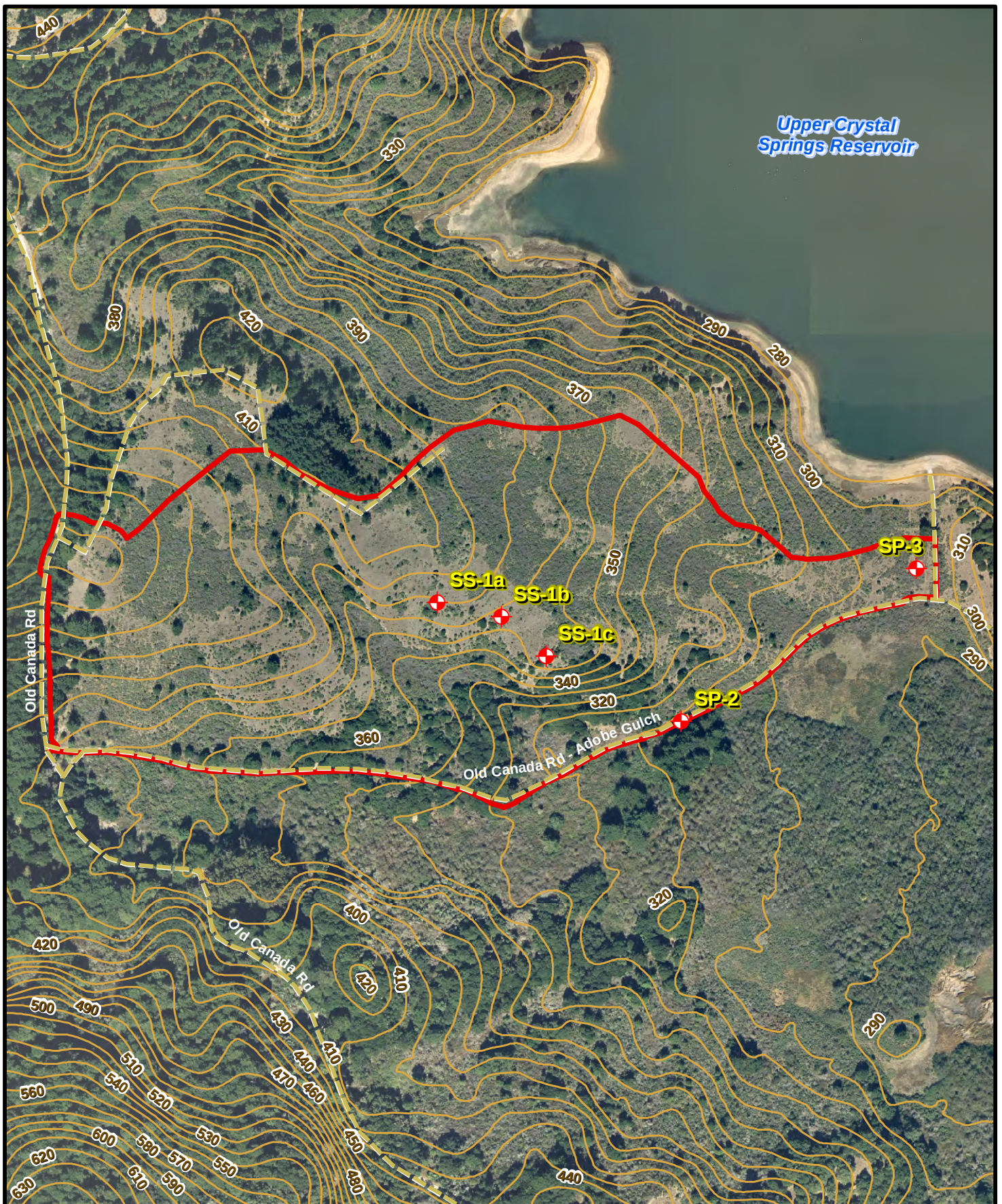
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0 225 450 900 Ft
1 inch = 450 feet

Adobe Gulch Project Area

Soil Sample/Soil Pit

Contours Index 10Ft

Roads on SFPUC land

Paved road

Unpaved road

Figure 5
Adobe Gulch
Grassland Restoration
Soil Sample Locations

Projection & Coordinate System:
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Vegetation Classifications

- CTP - Coastal Terrace Prairie
- CY - Monterey Cypress/Pine
- OW - Coast Live Oak Woodland

- SC - Northern Coyote Brush Scrub
- SW - Seasonal Wetland
- Adobe Gulch Project Area
- Unpaved road

Figure 6
Adobe Gulch
Grassland Restoration
Vegetation Classification
Existing Conditions

Projection & Coordinate System:
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0 250 500 1,000 Ft

1 inch = 500 feet



Adobe Gulch



Cypress - to be removed**



Oak - to be protected



Wetland

Unpaved road

Contours - Index (10 ft)

**isolated small cypress and pine throughout the site to be removed (not shown)

Figure 7 Adobe Gulch Grassland Restoration Tree Survey

Projection & Coordinate System:
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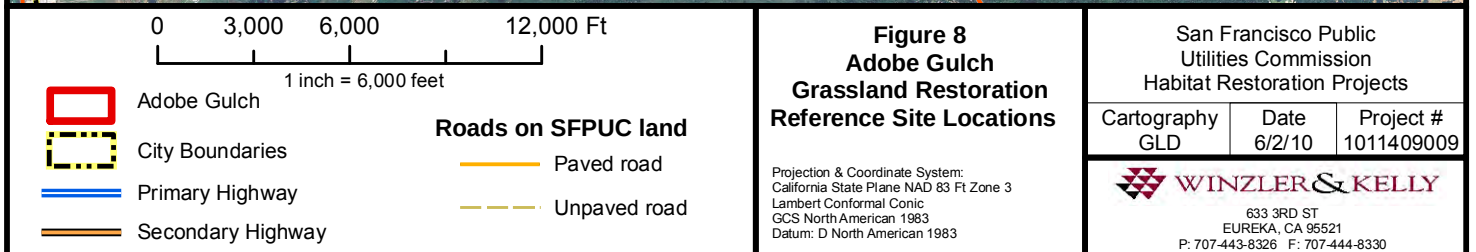
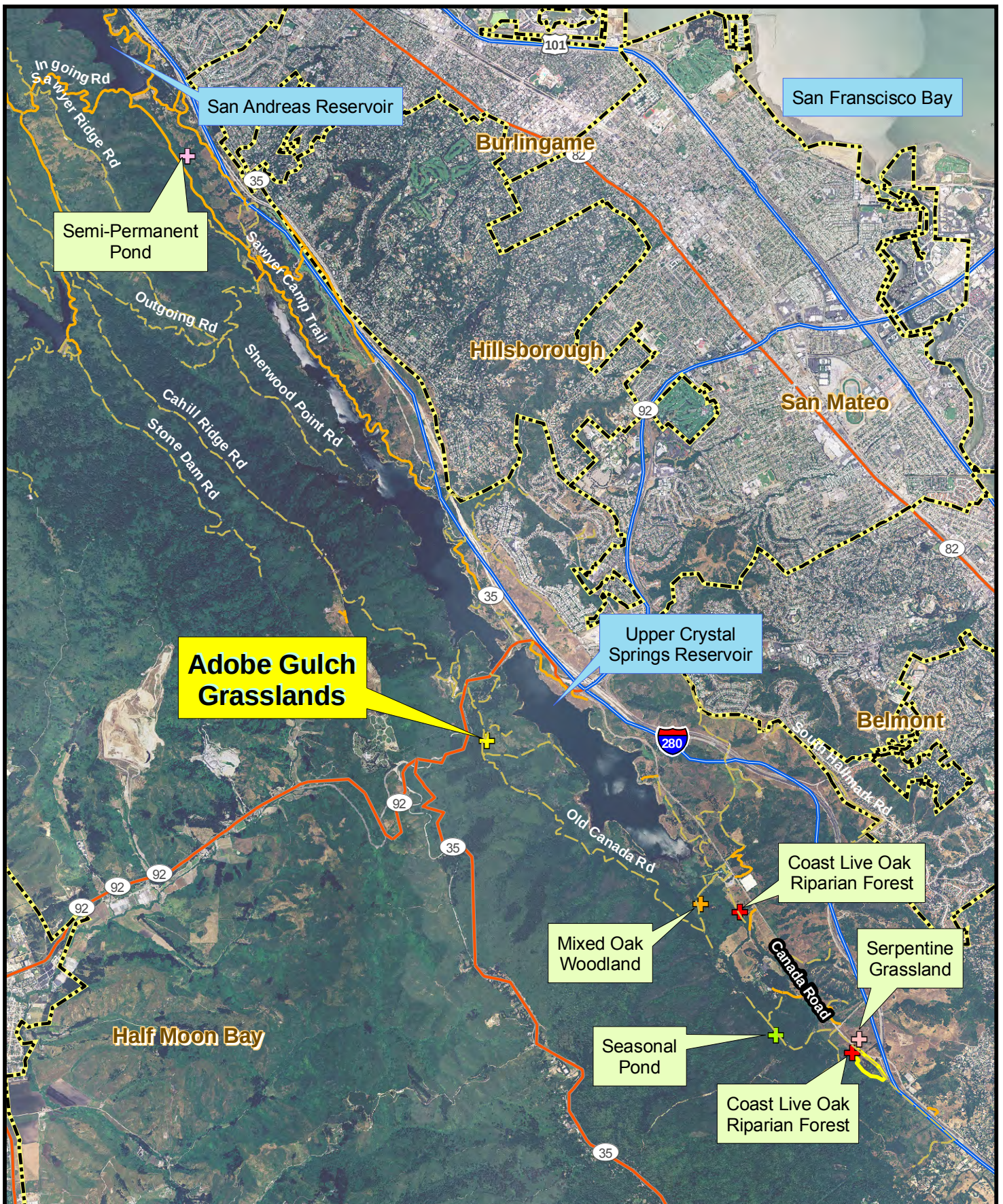
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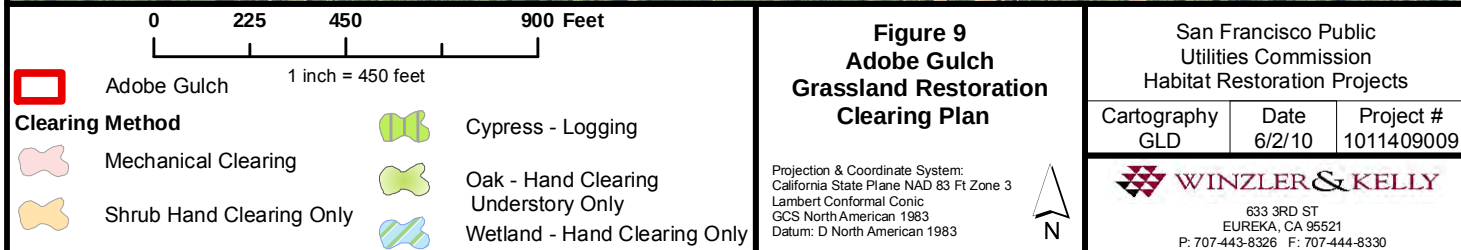
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0 225 450 900 Feet

1 inch = 450 feet



Adobe Gulch
Project Limits

Roads on SFPUC land

— Paved road

--- Unpaved road

— Existing Contours 10-ft

Proposed Grading Plan

— Index Contours 5-ft

— Contours 1-ft

**Figure 10a
Adobe Gulch
Grassland Restoration
Grading Plan -
Overview**

Projection & Coordinate System:
California State Plane NAD 83 Ft Zone 3
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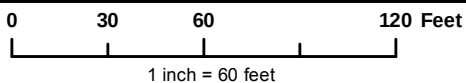
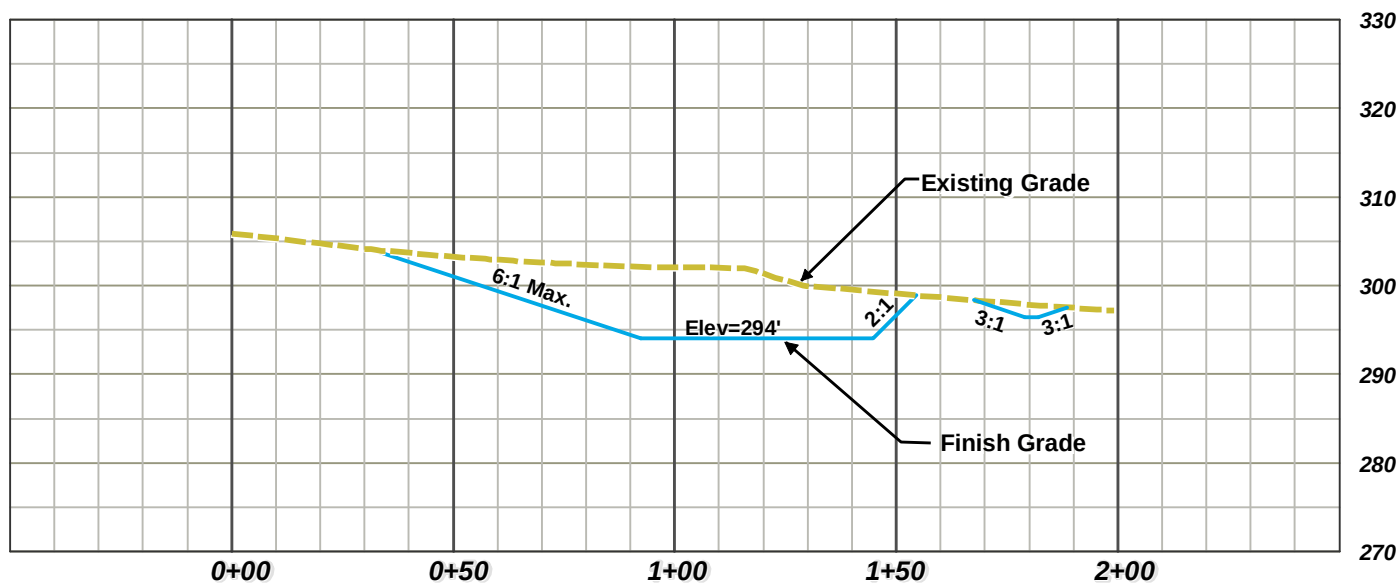
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- Adobe Gulch Project Limits
- Existing Index Contours 10-ft
- Wetland Boundary

- Proposed Grading Plan**
- Index Contours 5-ft
 - Contours 1-ft
 - Finish Grade

**Figure 10b
Adobe Gulch
Grassland Restoration
Grading Plan -
East Wetland**

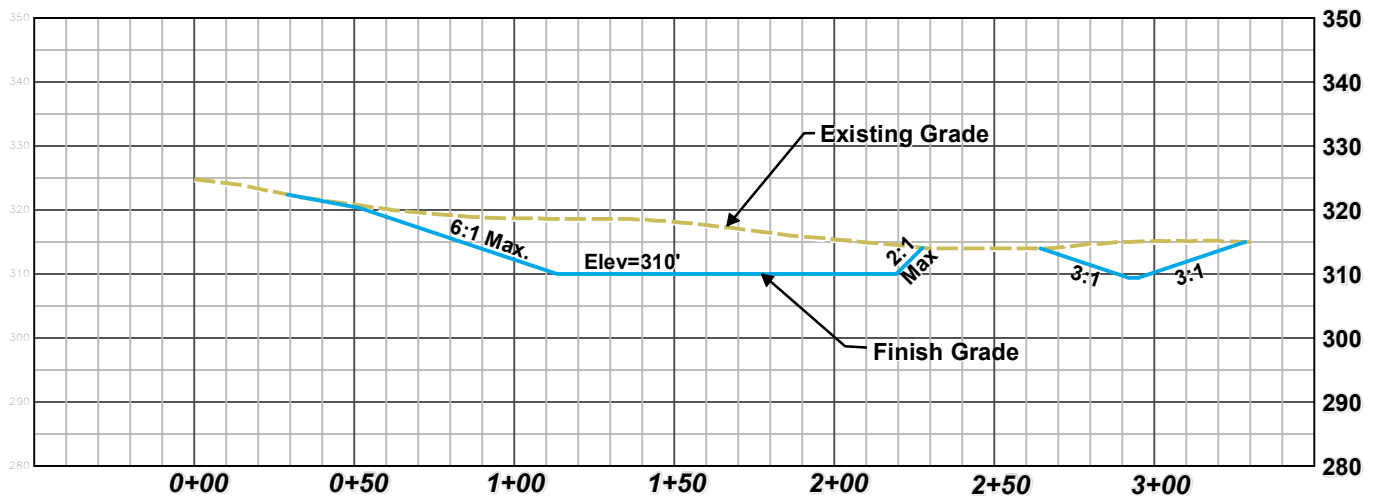
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California State Plane NAD 83 Ft Zone 3
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0 30 60 120 Feet
1 inch = 60 feet

- Adobe Gulch Project Limits
- Existing Index Contours 10-ft
- Wetland Boundary

- Proposed Grading Plan**
- Index Contours 5-ft
 - Contours 1-ft
 - Finish Grade

**Figure 10c
Adobe Gulch
Grassland Restoration
Grading Plan -
West Wetland**

Projection & Coordinate System:
California State Plane NAD 83 Ft Zone 3
Lambert Conformal Conic
GCS North American 1983
Datum: D North American 1983



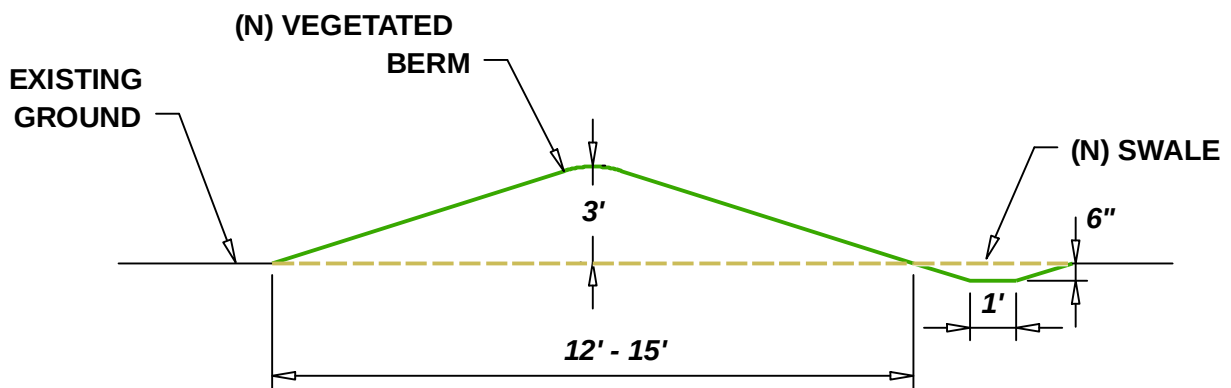
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0 110 220 440 Feet
1 inch = 225 feet

— Adobe Gulch Project Limits
— Existing Index Contours 10-ft

Proposed Grading Plan
— Index Contours 5-ft
— Contours 1-ft
— Finish Grade

Figure 10d
Adobe Gulch
Grassland Restoration
Grading Plan -
Oak Riparian Creation

Projection & Coordinate System:
California State Plane NAD 83 Ft Zone 3
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GCS North American 1983
Datum: D North American 1983

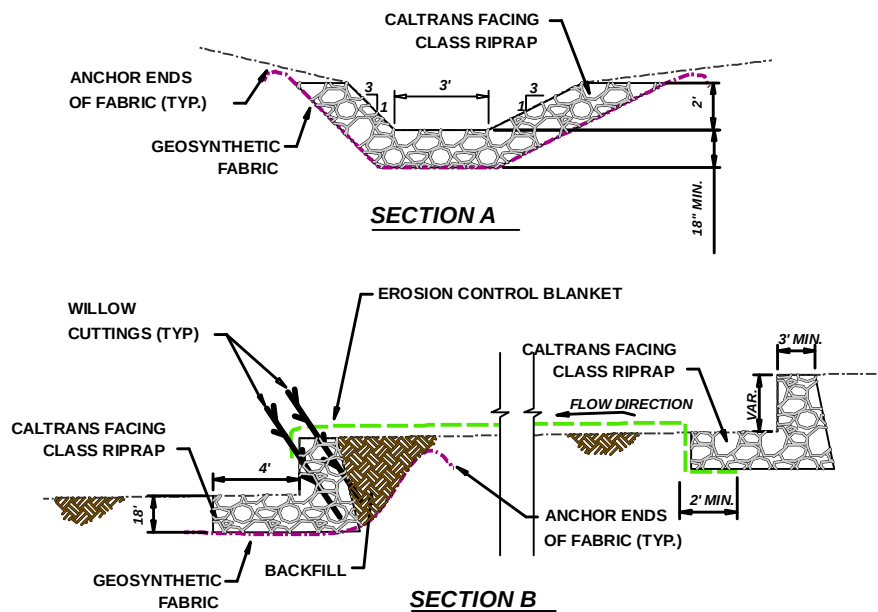
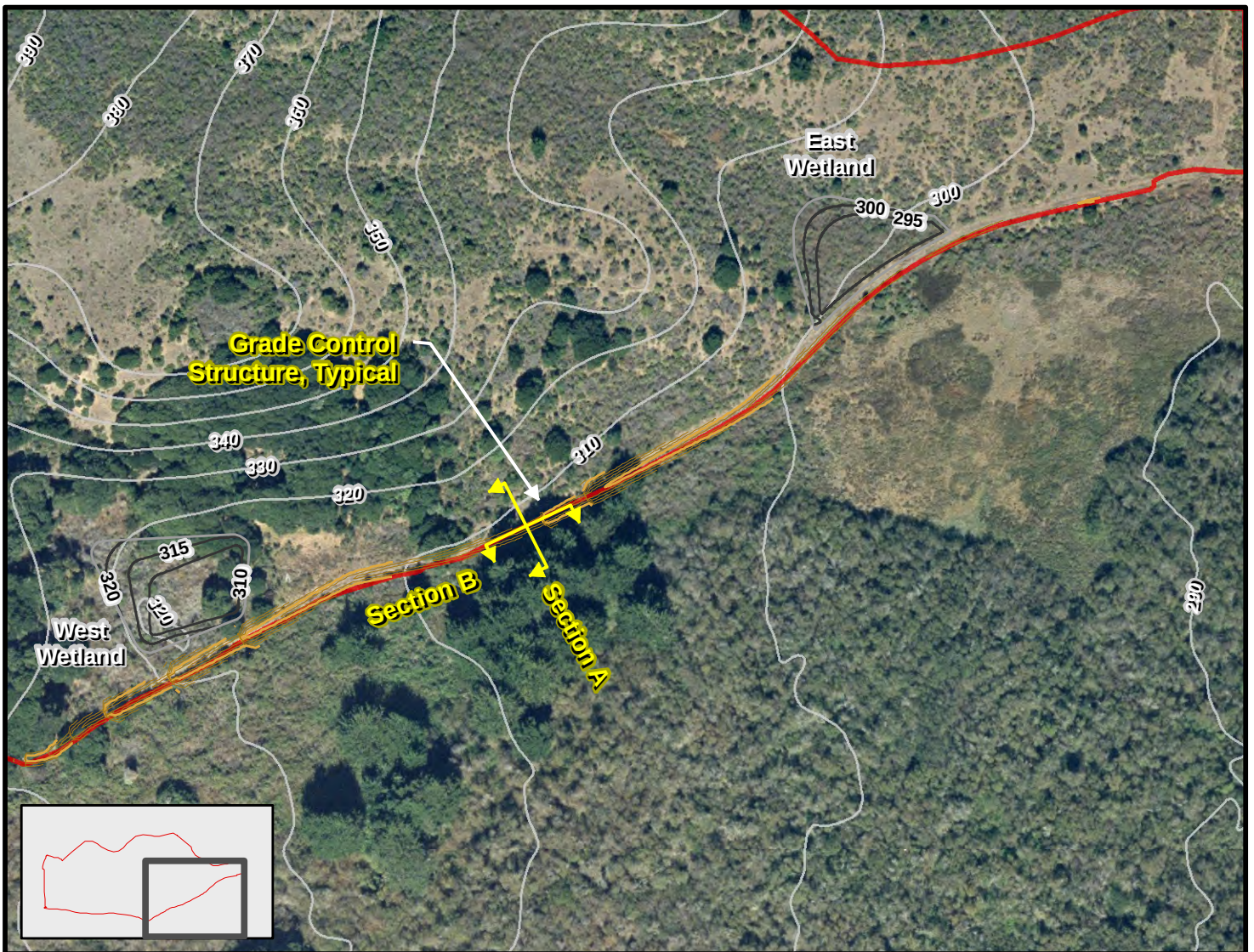


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- | | |
|---|--|
| — Adobe Gulch Project Limits | --- Geosynthetic Fabric |
| --- Existing Index Contours 10-ft | Proposed Grading Plan |
| --- Wetland Contours 5-ft | --- Index Contours 5-ft |
| --- Erosion Control Blanket | --- Contours 1-ft |

**Figure 10e
Adobe Gulch
Grassland Restoration
Grading Plan -
Riparian Restoration**

Projection & Coordinate System:
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Lambert Conformal Conic
GCS North American 1983
Datum: D North American 1983

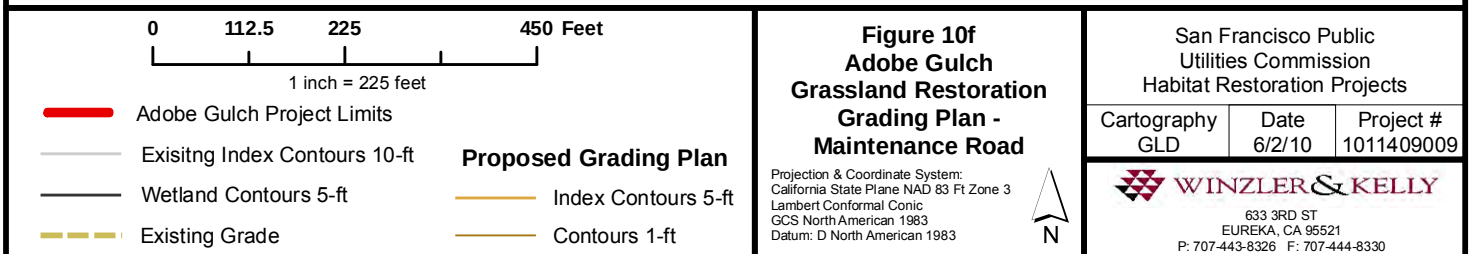
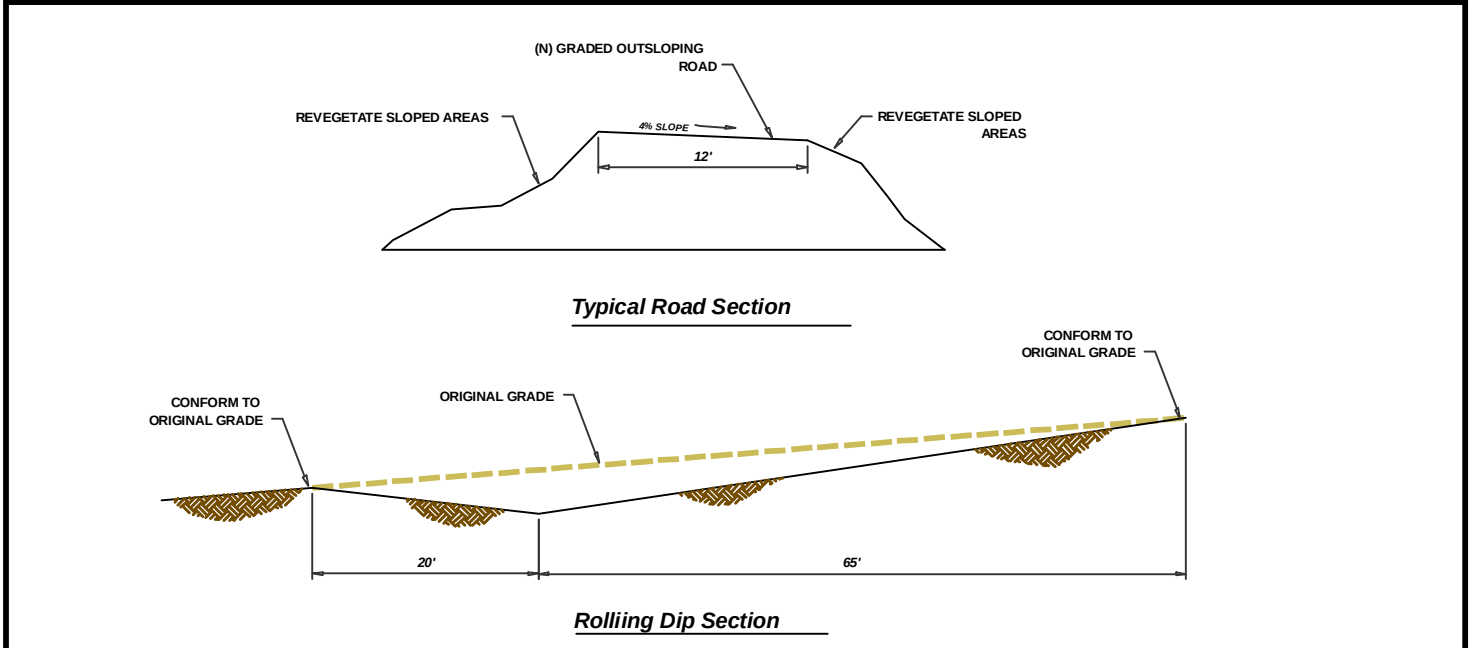


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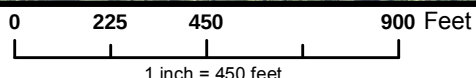
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Habitat Restoration Plan

- | | |
|--|--------------------------------|
| A - Oak Woodland Establishment (from Cypress clearing) | E - Grassland Enhancement |
| B - Oak Woodland Enhancement | F - Grassland Re-establishment |
| C - Oak Riparian Establishment | G - Wetland Enhancement |
| D - Willow Riparian Re-establishment | H - Wetland Establishment |



Adobe Gulch Roads

- Extend Existing Road
- Existing Road
- Realign Existing Road

SFPUC Roads

- Paved road
- Unpaved road

Figure 11
Adobe Gulch
Grassland Restoration
Planting Plan

Projection & Coordinate System:
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0 225 450 900 Feet

1 inch = 450 feet



Adobe Gulch



Permanent Stream



Intermittent Stream

Roads on SFPUC land



Paved road



Unpaved road

Figure 12
Adobe Gulch
Grassland Restoration
Management Units

Projection & Coordinate System:
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Appendix B

Site Photographs



View from north-central part of site, looking east: One of the larger remnant grassland openings, with encroaching scrub. Upper Crystal Springs reservoir is in right distance, SR 92 is in left distance. October 6, 2009.



View from north central part of site, looking west. Swale in foreground has coast live oak, Monterey pine, Monterey cypress, and shrubs. The “enchanted forest,” a large stand of mature Monterey cypress which borders the site to the west, is visible in the distance. Note the nearly unbroken scrub habitat in the middle distance. October 6, 2009.



View from the north central part of the site, looking south. This is the largest remnant grassland opening within the site. Note coast live oak at right, and dense scrub in the mid-distance. October 6, 2009.



View of the south boundary road, within the area proposed for riparian restoration, looking west. Note the shallow depression at the right of the road, which typically holds shallow water in the rainy season. October 6, 2009.



Closeup of small eroded gully bordering the south boundary road. October 6, 2009.



WINZLER & KELLY

TECHNICAL MEMORANDUM

Ref: 10114-09009-33038

TO: Ken Mierzwa, Project Biologist

CC: Carlo Quinonez, Project Engineer

FROM: Lia Webb, Soil Scientist

DATE: May 27, 2010

RE: **Soil Sampling and Fertility Analysis, SFPUC Adobe Gulch Grassland Restoration Site, San Mateo County, California**

Dear Ken:

This memo provides Winzler & Kelly's soil sampling methodology, soil fertility results, and recommendations for the above referenced site. The soil fertility results and recommendations will be incorporated as part of the Mitigation and Monitoring Plan (MMP) for grassland re-establishment / enhancement and creation of riparian and wetland mitigation areas.

Location

The project site is located within the Coast Ranges Geomorphic Province of California. It is situated on the northern and eastern foothills of the Santa Cruz Mountains, Montara Mountain, and within the San Andreas Fault Zone. The San Andreas Fault bisects the area in a northwesterly direction; ridges and streams also have a northwest-southeast orientation as a result. Some prominent physical features west of the San Andreas Fault Zone include Fifield Ridge, Sawyer Ridge, Cahill Ridge, Sweeney Ridge, and Montara Mountain; east of the San Andreas Fault Zone are Buri Buri Ridge and Pulgas Ridge.

Soils

The Soil Survey for Adobe Gulch maps the majority of the site as "Fagan loam, 15 to 50 percent slope" (Soil Survey Staff, 2009). A thin strip of Candlestick variant loam 2 to 15 percent slope is mapped along the road to the south of the project site, and Los Gatos loam 30 to 75 percent slope is mapped along Old Canada Road to the west of the site. The Fagan Series consists of shallow to deep, gently rolling to steep, well-drained upland soils. Although Fagan loams are derived from sandstone, they appear to contain some of the chemical attributes of soils derived from serpentinite, as extensive populations of serpentine-associated plants can be found on Fagan soils. The Fagan loam soil series is described as well drained, with approximately 40 to 60 inches of soil prior to paralithic contact, nonsaline, with moderate available water capacity (about 7.1 inches). A typical profile would have loam from 0-5 inches, clay loam from 5 to 26 inches, and clay from 26 to 43 inches depth. The land capability for nonirrigated crops is 6e which indicates severe limitations, generally unsuitable for cultivation and restricting use to mainly pasture, rangeland, forestland, or wildlife habitat. The Storie Index is Grade Three (Fair). Fagan soils are moderately suited for hand planting due to stickiness and high plasticity. The erosion hazard is moderate with a slope erodibility numeric value of 0.50 from off road/off-trail areas after

disturbance activities that exposed the soil surface, and is rated severe with a slope erodibility value of 0.95 for soil loss from unsurfaced road/trails. The numeric value indicates gradations between the point at which a soil feature has the greatest negative impact on the specified aspect of forestland management (1.00) and the point at which the soil feature is not a limitation (0.00). The Fagan soil is rated Severe (due to low soil strength) for the hazard of surface rutting through the operation of forestland equipment. Soil displacement and puddling (soil deformation and compaction) may occur simultaneously with rutting.

Soil Sampling

Soil sampling at shallow depths was conducted by installing 2-inch-diameter hand augured boreholes to the maximum depth possible (until refusal at bedrock or gravels). Soil samples were collected and logged to document observed soil conditions at the site. Surface and subsurface soil samples were collected at all sites for physical and chemical testing. These samples were submitted to a laboratory for chemical testing. Soil test pit boring logs are attached.

Grassland Re-establishment and Enhancement

Three soil pits (SP-1a, SP-1b, and SP-1c) were installed within the proposed shrub removal/grassland restoration area to total depths of 2.0 feet below ground surface (bgs), 2.0 feet, and 1.0 feet, respectively (Figure 5). Surface soil subsamples were collected at each soil pit from 0 to 6-inches depth. Subsurface samples were collected from the total depth of the soil auger hole at approximately 18-24-inches depth. Sub samples correlated by depth were composited into samples for laboratory analysis. In the shrub removal/grassland restoration area, the soils are characterized as loam at the surface underlain by sandy clay loam and a dense clay layer in the subsurface at around 2 feet depth.

Riparian Creation

An additional soil pit SP-2 was investigated from the proposed riparian restoration area, from the face/profile of an eroded ditch. The Adobe Gulch riparian area soils evaluated on the face/profile are described as loam at the surface underlain by clay loam from 1 to 2 feet bgs. Soil erodability is the main concern for this site due to the proposed installation of a riparian flow channel/meander with adjacent native plantings. The soil was characterized but no sample were collected from this location as soil fertility for growing riparian vegetation is not considered a concern at this site.

Wetland Creation

Soil pit SP-3 was installed in a proposed wetland area at the eastern end of Adobe Gulch Grasslands, near the road intersection with the reservoir. A subsurface soil sample was collected from 18-24 inches bgs. The Adobe Gulch Wetlands Creation site at soil pit SP-3, has loam at the surface underlain by a dense clay loam from 1 to 1.5 feet and that had presence of faint redoximorphic features (2%). From approximately 2.0 feet to total depth of 3.5 feet bgs the soil texture became coarser to a sandy clay loam with no reduced matrix or redoxomorphic features apparent from 2 to 3 feet bgs (see boring log, Appendix C), indicating that if groundwater is held at the site it would likely be perched in the finer textured surface layers. Wetland mitigation design for this location would either avoid digging deeper than the clay loam as the underlying

Soil fertility samples were collected at four locations at the Adobe Gulch Grasslands project site (Figure 5). Three subsample locations were selected in the area for shrub removal/grassland enhancement / re-establishment. These subsamples (SP-1a, SP-1b, SP-1c) were collected from 0-6 and 6-12 inches depth, and composited at a 3:1 ratio for laboratory analysis (laboratory ID SP10 and SP16, respectively). A fourth sample was collected in the proposed wetland area (SP-3) from a depth of 18 to 24 inches bgs (laboratory ID SP318). The soil was characterized in an eroded ditch from the profile face in the area proposed for riparian plantings (SP-2, no sample was collected from here as soil fertility for growing riparian vegetation is not considered a concern at this site). Soil pits SP-1 through SP-3 are shown on Figure 4 of the MMP, and boring logs for soil pits are attached.

The soil sample analytical results are summarized below in Table 3 and laboratory analytical reports are provided in Appendix C.

Table 3. Summary of Soil Fertility Analysis						
Sample	Depth (inches)	ID #	OM	Macronutrients-Primary (N/P1/P/K) ¹	Macronutrients-Secondary (Ca/Mg/S) ²	Micro-nutrients (Zn/Mn/Fe/Cu/B) ³
SP-1	0-6	SP10	H	L/VL/VL/M	L/VH/L	L/M/VH/M/L
SP-1	6-12	SP16	M	M/L/L/L	L/VH/L	VL/M/H/M/L
SP-3	18-24	SP318	L	L/VL/**/L	L/VH/L	VL/M/VH/H/VL
Summary of Soil Fertility Analysis (continued)						
Location	Depth (inches)	pH	CEC (meq/100g)	CEC % Saturation (K/Mg/Ca/H/Na)	Excess Lime Rating	Soluble Salts (mmhos/cm)
SP-1	0-6	6.2	14.9	2.5/32.3/52.3/12.0/1.0	L	VL
SP-1	6-12	6.5	18.8	1.3/46.6/42.9/7.5/1.7	L	VL
SP-3	18-24	6.0	17.4	1.1/41.6/40.5/15.0/1.8	L	VL
Code Rating: Very Low (VL), Low (L), Medium (M), High (H), Very High (VH) OM = organic matter (in percent and rating) CEC = Cation Exchange Capacity *Phosphorus measurement using Weak Bray (P1) method is unreliable at Medium or High excess lime or pH >7.5 **NaHCO₃-P unreliable at this soil pH 1. Primary Macronutrients are Nitrogen (N), Phosphorus using the Weak Bray test (P1), and Phosphorus using the Olson Method that measures NaHCO₃-P (P) 2. Secondary Macronutrients are Calcium (Ca), Magnesium (Mg), and Sulfur (S) 3. Micronutrients are zinc (Zn), Manganese (Mn), Iron (Fe), Cooper (Cu), Boron (B)						

Grassland Re-establishment and Enhancement

Of primary interest at soil pit SP-1 is surface and subsurface soil fertility to support grassland restoration, shrub removal/exclusion, and oak woodland boarder. The grassland restoration site (3:1 composite sample SP-1), the surface and subsurface samples had the following general notable results:

- Organic matter: medium to high levels;
- Primary macronutrients: low to medium levels of nitrogen and potassium, very low to low levels of phosphorus;
- Secondary macronutrients: low levels of calcium; very high levels of magnesium; low levels of sulfur;
- Micronutrients: very low to low levels of zinc and boron, medium levels of manganese, high to very high levels of iron, medium levels of copper;
- Cation Exchange Capacity (CEC) ranging from 14.9 to 18.8 meq/100g (up to 47% saturation of magnesium and up to 52% saturation from calcium);
- pH range of 6.2 to 6.5, with pH increasing with depth.

Wetland Creation

Sub-soil conditions are a primary interest at soil pit SP-3 for water holding potential for creation of proposed wetland and subsurface soil fertility conditions for plant growth. The sandy clay loam and sandy clay in the subsoil may promote subsurface percolation and therefore are not ideal for creation of wetland and wetland pond conditions; although the very dense nature of the subsoil coupled with the clay loam and clay texture may promote retention of water at the future surface of the proposed wetland mitigation area to be created. Preserving the surface soil during excavation of the wetland pond area is important for soil fertility as nutrient concentrations are typically greater in the surface soil. Stockpiling surface soil will allow addition of a dark A horizon from the stockpiled material to promote plant growth. The wetland restoration site (sample SP-3), the subsurface sample (18-24-inches bgs) had the following general notable results:

- Organic matter: low level in subsurface;
- Primary macronutrients: low level of nitrogen, low level of potassium, very low level of phosphorus;
- Secondary macronutrients: low level of calcium; very high level of magnesium; low level of sulfur;
- Micronutrients: very low levels of zinc and boron, medium level of manganese, very high level of iron, high level of copper;
- Cation Exchange Capacity (CEC) of 17.4 meq/100g (41.6% saturation of magnesium and 40.5% saturation from calcium);
- pH of 6.0.

Recommendations

The following recommendations are provided for consideration during the design and implantation of proposed site activities, as described by the Mitigation and Monitoring Plan:

- Soil fertility guidelines for use of these soils to support grassland (soil pit SP-1), recommends amending the soil with up to 100 pounds per acre gypsum to raise the calcium level from very low, and to provide an improved balance with magnesium (very high rating). The calcium to magnesium ratio is drastic, but native bunch grasses should be tolerant of local soil conditions.
- The fertility guidelines also recommend adding a nitrogen/phosphorus/potassium fertilizer, but this is not recommended for this site as it could stimulate invasive species and shrubs as well. The high organic content of the soil will provide some nutrients for proposed native plantings. Adaptive management should be used to determine post-planting if particular nutrients are inhibiting plant growth, and will be evaluated during the annual monitoring.
- The wetland pond area should be excavated down to the clay loam horizon (dense clay loam horizon approximately 13 to 18 inches depth) or down to the clay layer (approximately 3 feet depth) to avoid intercepting the sandy clay loam or sandy clay layer as the bottom of the pond. If excavating down to 3 feet depth to utilize the clay horizon as a pond liner, stockpile dark surface soil to allow addition of dark A horizon from stockpiled material to promote plant growth. This can also be if only excavating to approximately 13 inches to reach the clay loam horizon as well, but the additional layer of top soil must be thin enough to keep the wet weather groundwater table within 12 inches of the service.
- Conclusion: Although the lab recommends applying soil amendments, the application of amendments may affect the pH of the water, cause eutrophication, and nutrients could move offsite due to water movement. Nutrient use could also encourage growth and completion of invasive species.
- Based on results and interpretation of these samples, no treatment is recommended for project site soils.

Attached:

Exploration Hole Logs

Soil Analysis Report (Analytical)

Soil Fertility Guidelines (Analytical)

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1311 WOODLAND AVE #1 | MODESTO, CALIFORNIA 95351 | (209) 529-4080 | FAX (209) 529-4736



REPORT NUMBER: 09-334-021

CLIENT: 2664-D

SUBMITTED BY: LIA WEBB

SEND TO: WINZLER & KELLY ENGINEERS
633 THIRD STREET
EUREKA, CA 95503-

GROWER: REF#10114-09009-33035

DATE OF REPORT: 12/07/09

SOIL FERTILITY GUIDELINES

RATE: /1000 sq

PAGE: 1

Sample ID	Lab Number	Crop	SOIL AMENDMENTS				Nitrogen N	Phosphate P ₂ O ₅	Potash K ₂ O	Magnesium Mg	Sulfur SO ₄ -S	Zinc Zn	Manganese Mn	Iron Fe	Copper Cu	Boron B
			Dolomite	Lime	Gypsum	Elemental Sulfur										
SP-10	54199	GRASSLAND		50			3.0	2.5	3.5		0.6	*				
SP-16	54200	GRASSLAND			100		2.8	2.5	4.5			*				
SP318	54201	WETLAND		70			3.2	4.5	4.5		0.6	*				*
SP430	54202	WETLAND			250	30	3.1	2.0	4.5			*	*			*
SP-50	54203	GRASSLAND			230		2.3	2.0	5.0			*				

DEPTH OF SAMPLING: Soil fertility could differ greatly with depth. Concentrate on amending and fertilizing the topsoil zone only, but take note of trends down the profile that may need attention.

C MAGNESIUM: If base saturation exceeds 25% one may encounter drainage problems and potassium uptake may be hindered. Extra calcium may provide some benefit, but source should depend on soil pH.

O AS A GUIDELINE using gypsum, (C.E.C. on report x 130) - (ppm calcium on report) x 0.115 = lb of gypsum required per 1000 sq ft of area to raise a 3-inch depth of soil to 65% calcium saturation.

M PRIOR TO PLANTING: Spread the above requirements per 1,000 sq ft and mix into the top 6-8 inches of soil. Initially, limit nitrogen to 1.5 lb/1,000 sq ft or 25-30 ppm NO₃-N to avoid salt damage.

N SPLIT any extra nitrogen evenly over the active growing season. Adjust rate according to local conditions and requirements. Allow for adequate establishment first (up to 30 days).

T

S

NOTES:

Mike Buttress

Mike Buttress, CPAg

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SOIL FERTILITY GUIDELINES

RATE: /1000 sq

PAGE: 2

Sample ID	Lab Number	Crop	SOIL AMENDMENTS				Nitrogen N	Phosphate P ₂ O ₅	Potash K ₂ O	Magnesium Mg	Sulfur SO ₄ -S	Zinc Zn	Manganese Mn	Iron Fe	Copper Cu	Boron B
			Dolomite	Lime	Gypsum	Elemental Sulfur										
SP-56	54204	GRASSLAND			250		3.1	2.0	5.0			*				*
SP-60	54205	WETLAND		90			3.0	3.5	3.5		0.6	*				*
SP624	54206	WETLAND		70			3.2	4.0	3.5		0.6	*	*			*

MICRONUTRIENTS: Where levels appear to be high, avoid any further applications for the time being.

NOTES:

- C** Very high (VH) levels may not necessarily be toxic, but avoid. Maintain correct soil pH.
- O** HIGH levels of organic matter should have a beneficial effect on growth and "soil" pH may not be as critical. However, watch carefully as amendments and extra nitrogen may still be necessary.
- M** * MICRONUTRIENTS: Where levels are low, apply according to label instructions. Maintaining correct soil pH and adequate organic matter levels may be sufficient to correct deficiencies.
- N** * BORON may not necessarily be deficient in the soil, and it is hard to correct an excessive application. Therefore, apply boron only if confirmed deficient through a leaf analysis.
- T**
- S** WETLAND VEGETATION may include willow, cottonwood, swamp privet, green ash, rushes and sedges. Many species of oak, maple, hickory and rose, may also withstand long wet periods in certain areas.

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MB Buttruss

Mike Buttruss, CPAg

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SOIL ANALYSIS REPORT

PAGE: 1

SAMPLE ID	LAB NUMBER	Organic Matter		Phosphorus		Potassium	Magnesium	Calcium	Sodium	pH		Hydrogen	Cation Exchange Capacity	PERCENT CATION SATURATION (COMPUTED)				
		*	**	P1	NaHCO ₃ -P	K	Mg	Ca	Na	Soil pH	Buffer Index	H		K	Mg	Ca	H	Na
		% Rating	ENR lbs/A	(Weak Bray) **** *	(Olsen Method) **** *	**** *	*** *	*** *	*** *			meq/100g	C.E.C. meq/100g	%	%	%	%	%
SP-10	54199	4.1H	112	6VL	7VL	145M	584VH	1561L	33VL	6.2	6.8	1.8	14.9	2.5	32.3	52.3	12.0	1.0
SP-16	54200	3.0M	89	9L	7L	97L	1066VH	1619L	73L	6.5		1.4	18.8	1.3	46.6	42.9	7.5	1.7
SP318	54201	1.9L	68	7VL	5**	77L	878VH	1412L	70L	6.0	6.7	2.6	17.4	1.1	41.6	40.5	15.0	1.8
SP430	54202	4.3H	116	5 *	8M	129L	2954VH	1018VL	45VL	8.0		0.0	29.9	1.1	81.2	17.0	0.0	0.7
SP-50	54203	13.3VH	295	12L	18M	80L	1846VH	677VL	92L	6.5		1.6	20.7	1.0	73.3	16.3	7.5	1.9

* Weak Bray unreliable at M or H excess lime or pH > 7.5 ** NaHCO₃-P unreliable at this soil pH

SAMPLE NUMBER	Nitrogen	Sulfur	Zinc	Manganese	Iron	Copper	Boron	Excess	Soluble	Chloride	PARTICLE SIZE ANALYSIS			
	NO ₃ -N	SO ₄ -S	Zn	Mn	Fe	Cu	B	Lime	Salts	Cl	SAND	SILT	CLAY	SOIL TEXTURE
	ppm	ppm	ppm	ppm	ppm	ppm	ppm	Rating	mmhos/cm	ppm	%	%	%	
SP-10	9L	5L	1.0L	10M	38VH	1.0M	0.4L	L	0.2VL					
SP-16	16M	5L	0.3VL	10M	25H	1.1M	0.4L	L	0.2VL					
SP318	9L	6L	0.2VL	10M	37VH	1.5H	0.2VL	L	0.1VL					
SP430	7L	7L	0.3VL	2L	19H	1.4H	0.3VL	L	0.1VL					
SP-50	5L	3VL	1.0L	9M	31VH	0.6L	0.4L	L	0.3L					

* CODE TO RATING: VERY LOW (VL), LOW (L), MEDIUM (M), HIGH (H), AND VERY HIGH (VH).

** ENR - ESTIMATED NITROGEN RELEASE

*** MULTIPLY THE RESULTS IN ppm BY 2 TO CONVERT TO LBS. PER ACRE OF THE ELEMENTAL FORM

**** MULTIPLY THE RESULTS IN ppm BY 4.6 TO CONVERT TO LBS. PER ACRE P₂O₅

***** MULTIPLY THE RESULTS IN ppm BY 2.4 TO CONVERT TO LBS. PER ACRE K₂O

MOST SOILS WEIGH TWO (2) MILLION POUNDS (DRY WEIGHT) FOR AN ACRE OF SOIL 6-2/3 INCHES DEEP

This report applies only to the sample(s) tested. Samples are retained a maximum of thirty days after testing.

MB att:use

Mike Buttress, CPAg
A & L WESTERN LABORATORIES, INC.

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SOIL ANALYSIS REPORT

PAGE: 2

SAMPLE ID	LAB NUMBER	Organic Matter		Phosphorus		Potassium	Magnesium	Calcium	Sodium	pH		Hydrogen	Cation Exchange Capacity	PERCENT CATION SATURATION (COMPUTED)				
		*	**	P1	NaHCO ₃ -P	K	Mg	Ca	Na	Soil pH	Buffer Index	H meq/100g	C.E.C. meq/100g	K %	Mg %	Ca %	H %	Na %
		% Rating	ENR lbs/A	(Weak Bray) **** *	(Olsen Method) **** *	**** *	*** *	*** *	*** *									
SP-56	54204	4.3H	115	6VL	12M	74L	2330VH	469VL	117L	7.2		0.0	22.2	0.9	86.3	10.5	0.0	2.3
SP-60	54205	4.4H	118	11L	15**	179M	679VH	1334L	88L	5.8	6.6	3.1	16.2	2.8	34.6	41.2	19.0	2.4
SP624	54206	3.2M	93	9L	10**	159M	708VH	1459L	68L	5.9	6.7	2.8	16.6	2.4	35.0	43.8	17.0	1.8

** NaHCO₃-P unreliable at this soil pH

SAMPLE NUMBER	Nitrogen	Sulfur	Zinc	Manganese	Iron	Copper	Boron	Excess	Soluble	Chloride	PARTICLE SIZE ANALYSIS			
	NO ₃ -N ppm	SO ₄ -S ppm	Zn ppm	Mn ppm	Fe ppm	Cu ppm	B ppm	Lime Rating	Salts mmhos/cm	Cl ppm	SAND %	SILT %	CLAY %	SOIL TEXTURE
SP-56	6L	6L	0.5VL	6M	20H	0.6L	0.3VL	L	0.2VL					
SP-60	9L	5L	1.0L	5M	80VH	0.8L	0.2VL	L	0.3L					
SP624	7L	8L	0.4VL	2L	70VH	1.2M	0.2VL	L	0.2VL					

* CODE TO RATING: VERY LOW (VL), LOW (L), MEDIUM (M), HIGH (H), AND VERY HIGH (VH).

** ENR - ESTIMATED NITROGEN RELEASE

*** MULTIPLY THE RESULTS IN ppm BY 2 TO CONVERT TO LBS. PER ACRE OF THE ELEMENTAL FORM

**** MULTIPLY THE RESULTS IN ppm BY 4.6 TO CONVERT TO LBS. PER ACRE P₂O₅

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MOST SOILS WEIGH TWO (2) MILLION POUNDS (DRY WEIGHT) FOR AN ACRE OF SOIL 6-2/3 INCHES DEEP

This report applies only to the sample(s) tested. Samples are retained a maximum of thirty days after testing.

MB attwse

Mike Buttress, CPAg
A & L WESTERN LABORATORIES, INC.

Adobe Gulch Grasslands Hydrology Report

June 2010

Prepared for



Prepared by



Section 1 Introduction

The Adobe Gulch Grasslands project is included in the San Francisco Public Utilities Commission (SFPUC) Habitat Reserve Program, which mitigates for the Water System Improvement Program (WSIP). The Adobe Gulch Grassland Restoration project proposes to:

- rehabilitate 49.7 acres of grassland, enhance 0.2 acres of seasonal wetland
- establish 0.5 acres of seasonal wetland
- enhance and establish 9.2 acres of coast live oak woodland
- re-establish 0.9 acre/1,135 linear feet of arroyo willow riparian forest
- establish 1.0 acre/1,400 linear feet of coast live oak riparian forest.

The proposed mitigation activities will lengthen the hydroperiod of existing wetlands by reducing evapotranspiration and slowing runoff, and create new seasonal wetlands, potentially increasing survival of Pacific tree frog tadpoles, and also providing foraging habitat for California red-legged frogs, San Francisco garter snakes, and western pond turtles. Winzler & Kelly's team is providing environmental planning, biologic, hydrologic and engineering design services. This Report summarizes the hydrologic analysis that serves as a basis for the design of the proposed seasonal wetlands and arroyo riparian forest.

Section 2 Existing Conditions

Adobe Gulch Grasslands Watersheds

Refer to **Figure 1** for watershed data. The watershed delineations were based on topographic data gathered from the SFPUC, USGS digital elevation models, and additional survey points collected by SFPUC at the project site.

Figure 2 shows the Adobe Gulch Grasslands project area. The Adobe Gulch Grasslands site is characterized by rolling terrain, with a low swale trending northwest to southeast through the center of the site. Elevations within the 62-acre site range from less than 300 feet on the east to just over 450 feet on the west.

There are seven sub-watersheds (WS-0 through WS-6) that provide water to the Adobe Gulch Grasslands project area, having a total area of approximately 478 acres. Landuse for the sub-watersheds include shrub land, grassland and mixed forest. The watersheds characteristics are summarized in **Table 1**.

Table 1 – Watershed Characteristics

Watershed	Area (acres)	Drainage Length (ft)	High Elev (ft)	Low Elev (ft)	Δ Elev (ft)	Average Slope (ft/ft)
WS-0	46.2	5757	1040	270	770	0.13
WS-1	82.6	4248	1036	270	766	0.18
WS-2	251.5	4770	1152	270	881	0.18
WS-3	22.4	1630	300	205	95	0.06
WS-4	22.2	1521	305	188	117	0.08
WS-5	26.9	1641	563	256	307	0.19
WS-6	26.1	1165	341	252	89	0.08

Runoff from WS-0 through WS-2 and WS-5 is conveyed through localized gullies to the intermittent stream that is located to the south of the project area as shown in **Figure 2**. The intermittent stream flows east to Upper Crystal Springs Reservoir. Due to the relatively flat topography and dense vegetation, approximately 1000 feet downstream of Old Cañada Road, the stream becomes braided with many branches that drain into an existing wetland and into Upper Crystal Springs Reservoir.

Runoff from watersheds WS-3, WS-4 and WS-6 currently drain to the existing access road that runs along the southern border of the project area. The access road conveys the runoff towards the east where it drains into the existing wetland south of the project area and eventually into Upper Crystal Springs Reservoir. A branch of the intermittent stream parallels the eastern half of the access road to the south and contributes flow to the access road by way of a natural diversion caused by dense vegetation and low channel banks.

Field Data

Figure 2 indicates the locations of stream and groundwater gage, and **Table 2** summarizes data used in this report. Winzler & Kelly installed an automated water level gage (stream gage) in the intermittent stream downstream from the Old Cañada Road crossing. Data from the stream gage was collected on an hourly basis, from January 2010 through April 2010, and was converted to flow using the channel geometry from field data and Manning's equation. A rating curve for the channel was created for use in the hydrologic model. The stream gage data can be viewed in **Appendix A**.

Table 2 – Summary of Field Data

Source	Type	Period	Application
Winzler & Kelly	Stream Gage/Water Level	01/10 - 04/10	Hydrologic Model Calibration
Balance Hydrologics	Piezometer	04/97- 08/98	Wetland Drawdown Time
SFPUC	Rain Gage	10/09 - 5/10	Hydrologic Model Calibration

A piezometer was installed in the existing wetland by Balance Hydrologics to measure the ground water levels during the spring and summer drying period. The piezometer was installed in April 1997 and, monitoring occurred from the date of installation through the August of 1998. Winzler & Kelly monitored the piezometer from January 2010 through May 2010. Based on the *Conceptual Hydrologic Approaches and Plans for Mitigation Wetlands at Crystal Springs Reservoir* prepared by Balance Hydrologics on September 1999, the groundwater recession (1.2 inches/day) was approximately the same in 1997 and 1998. Piezometer data collected by Winzler & Kelly were lacking a ground water recession curve because the rainy season extending through May. The Balance Hydrologics piezometer data was therefore used in this analysis and can be viewed in the September 1999 report.

Figure 2 indicates the locations of piezometers and stream gage.

Hourly Rainfall data from the Crystal Springs Cottage gage station, located approximately 1 mile southeast of Adobe Gulch Grasslands, was used in this analysis. The rain gage data for January 2010 through March 2010 were correlated with the stream gage data to develop a calibrated hydrologic model of the delineated watershed. Historical rain data were entered into the calibrated model to determine the runoff volume available for the proposed wetlands on an annual basis. This volume was used as the basis for the sizing of the proposed seasonal wetlands and determining what impact, if any, retaining additional runoff in the wetland would have on existing hydrodynamics. Cumulative and rainfall data for 1999 through 2010 and incremental rainfall data for the 2009/2010 rainfall can be viewed in **Appendix A**.

Hydrologic Model

Extended Period Simulation

The United States Army Corps of Engineers hydrologic software model, HEC-HMS, was used for this analysis. An Extended Period Simulation (EPS) model was developed using rain gage data from the Crystal Springs Cottage gage station. An EPS model computes runoff as a result of a rainfall event or series of events input by the user. This is different from event-based modeling, which simulates runoff from a statistical storm event, such as the 100-year, 24-hour storm. An EPS model is suited for the analysis of Adobe Gulch Grasslands because the design criteria for the proposed wetlands are based on the historical seasonal volume of water from the respective sub-watersheds and not on a single event. Hourly precipitation data extending from January 24, 2010, through March 19, 2010, was used to calibrate the HEC-HMS model with the observed stream gages. Once calibrated, the HEC-HMS model used hourly rain data from October 1999 through March 2010 for an analysis of the effects of dry, average and wet rainfall years on the proposed wetlands.

The HEC-HMS model was calibrated by adjusting parameters of each sub-watershed within a threshold that depicts the hydrologic characteristics of each sub-watershed. The parameters adjusted were the rainfall losses associated with infiltration and the storage coefficient within the hydrograph convolution method. Due to the location of the stream gage, the model was calibrated using sub-watersheds WS-0 through WS-2, the only contributing sub-watersheds at the stream gage location. The calibrated parameters for WS-0 through WS-2 were then extrapolated to characterize sub-watersheds WS-3 through WS-6.

Rainfall Losses

The Deficit Constant Loss method was used to account for losses due to infiltration. This method is appropriate for extended period simulations as it accounts for evapotranspiration and the resulting drying of soil in between storms. Initial inputs are based on NRCS soil properties shown in **Appendix B**. The model modifies the most sensitive parameter, the constant rate of loss (inches/hour), during model calibration. **Appendix C** shows the sub-watersheds final values for the rainfall losses.

Hydrograph Convolution

The Clark Unit Hydrograph synthetic unit hydrograph method was used for hydrograph convolution. This method uses time of concentration to define the maximum travel time within a sub-watershed and applies a storage coefficient to simulate attenuation of flow. The storage coefficient, R, is an index of precipitation excess in the watershed as it drains to the outlet point. Though R has units of time (hr), there is only a qualitative meaning for the value. As recommended by the *Hydrologic Modeling System HEC-HMS Technical Reference Manual* (March 2000), "R can be estimated via calibration if gaged precipitation and stream flow data are available." The HEC-HMS model was used in conjunction with the observed 2009/2010 rainfall and stream gage data to estimate the value of R. **Appendix C** shows the calibrated parameters.

Calibrated Model

The calibrated HEC-HMS existing conditions model using 2009/2010 rainfall and stream gage data predicts the volume within an acceptable level of accuracy. The model output hydrograph and the hydrograph generated from data collected by the main channel stream gage are shown in **Figure 3**. **Table 3** compares observed versus modeled output.

Table 3 - Output Comparison

	Total Runoff Volume (ac-ft)
Computed Results	192.7
Observed Stream Gage Results	173.7
% Error from Observed	10.9%

Section 3 Proposed Wetlands

Design Criteria

The proposed wetlands are intended to serve as seasonal wetlands, defined for the purpose of this project as potentially increasing survival of Pacific tree frog tadpoles, and also providing foraging habitat for California red-legged frogs, San Francisco garter snakes and western pond turtles. During an average year of rainfall, it is the design goal that the wetlands hold water until May.

Based on information provided by SFPUC, Swaim Biological, and local successful frog ponds, Winzler & Kelly developed conceptual elements for the proposed wetlands. Design concepts include incorporation of a mild bank slope into a shallow end to allow access and to promote vegetative growth, incorporation

of a steep bank slope at a deep end to provide shelter from predators; incorporation of structure within the pond for additional shelter. The proposed grading plan is based on these concepts.

Geometry

The size of the proposed wetlands is limited by site constraints, such as existing wetlands, topography and available volume of water from the respective watersheds. The area and depth of the proposed wetlands maximizes the amount of created seasonal wetlands needed by SFPUC for mitigation and minimizes the volume of water intercepted from the watersheds. Refer to **Figure 2** for the proposed footprint of the proposed wetlands. The proposed wetlands will have varying depths with a maximum ponding depth of 4 feet creating 0.55 acre-feet of storage in the western wetland and 0.52 acre-feet in the eastern wetland.

Hydrologic Model

Proposed Wetland Filling

The calibrated HEC-HMS model was used to quantify the volume of runoff available for the proposed wetlands shown in **Figure 2**. Based on the calibrated HEC-HMS model for the 2009/2010 rainy season, there was approximately 32.2 acre-feet of water from WS-3 which will feed the proposed western wetland and 31.8 acre-feet of water from WS-4 which will supply water to the proposed eastern wetland. **Table 4** provides the calculated historical volume of water available to the proposed wetlands. As shown in the table, the proposed size of the wetlands is a negligible percentage of the total available volume. The historical volume quantities are based on hourly rainfall data from the Crystal Springs Cottage rain gage from October 1999 through March 2010 and the calibrated HEC-HMS model. Based on the historical rain data, the wetlands are likely to fill after the first storm event.

Table 4 – Historical Water Volume

Rainy Season	WS-3 (Western Wetland) (ac-ft)	WS-4 (Eastern Wetland) (ac-ft)
1999/2000	39.9	39.4
2000/2001	31.8	31.4
2001/2002	30.8	30.4
2003/2004	33.6	33.3
2004/2005	49.3	48.7
2005/2006	50.4	49.8
2006/2007	19.9	19.7
2007/2008	35.1	34.7
2008/2009	32.2	31.8
2009/2010	32.2	31.8

*2002/2003 data not shown because of missing rainfall data for that season

Wetland Draining

A calibrated hydrologic recession model was also used to determine historically when the water surface elevation (WSE) begins to recede. The hydrologic recession model accounts for the WSE after the last

rainfall event and begins draining the pond due to losses. The losses in the pond are associated with infiltration and evapotranspiration. The infiltration rate, 1.2 inches per day, is based on the piezometer groundwater recession trend from the 1999 Balance Hydrologics report. The evapotranspiration rates are based on monthly averages from the California Irrigation Management Information System (CIMIS) evapotranspiration gage #96 located in Woodside, CA. The monthly average evapotranspiration rates are shown in **Appendix C.**, and range from 1.83 to 6.47 inches per month.

Based on the calibrated hydrologic runoff model, calibrated hydrologic pond recession model, and the proposed pond geometry, estimated date that the proposed pond would have historically been dry is summarized in **Table 5**. The recession of the WSE can be viewed in **Figure 4**.

Table 5 – Estimated Historical Drying Date for the Proposed Wetlands

Rainy Season	Estimated Dry Date	Classification
1999/2000	April 15, 2000	Wet
2000/2001	April 11, 2001	Average
2001/2002	February 9, 2002	Average
2003/2004	April 5, 2004	Dry
2004/2005	May 5, 2005	Wet
2005/2006	May 21, 2006	Wet
2006/2007	April 6, 2007	Dry
2007/2008	April 1, 2008	Average
2008/2009	April 11, 2009	Dry
2009/2010	May 30, 2009	Wet

Proposed Creek

Currently, a portion of the runoff from the branch of the intermittent channel that parallels the access road is diverted to the road where it sheet flows toward the existing wetland that is south of the project area as shown in **Figure 2**. As part of the SFPUC mitigation, the section of the access road where the sheet runoff occurs is going to be converted into riparian habitat, which will include a stable intermittent creek. Using the existing intermittent creek upstream of Old Cañada Road as a reference reach, stable sections of the creek have a 3 to 4 foot bottom width and a 1 to 2 foot bank height with a flood plain for overbank flows on at least one side of the creek. A picture of a typical channel cross section of the intermittent creek is provided in **Appendix D**.

It is not anticipated that the flow recorded by the stream gage and modeled in the calibrated HEC-HMS model will be conveyed in the proposed creek because of the complex nature of the channel once it becomes a braided stream. Currently, only a portion of the total flow for the Adobe Gulch Grasslands watershed (WS-3, WS-4, and WS-6) is diverted towards the access road, the rest flows to the intermittent channel, towards the reservoir. Quantifying the flow that is diverted would require significantly more data and possibly a two-dimensional hydraulic model. Therefore, to be conservative, the proposed creek was designed to withstand the peak flow, velocity, and shear stress of the total runoff from the watershed. The historical peak flows at the downstream junction of all the sub-

watersheds, Junction-A shown on **Figure 1 and 2**, for the calibrated HEC-HMS model are presented in **Table 6**.

Table 6 – Historical Peak Flow at Downstream Junction

Rainy Season	Peak Flow (cfs)
1999/2000	41.9
2000/2001	22.4
2001/2002	26.7
2003/2004	29.5
2004/2005	28.9
2005/2006	36.5
2006/2007	19
2007/2008	54.7
2008/2009	53
2009/2010	37.1

The channel geometry of the proposed creek is based on the section of the stable intermittent stream located upstream of Old Cañada Road. The proposed geometry of the creek has a 3 foot bottom width and side slopes at 3:1 (horizontal:vertical). The minimum depth of the proposed channel is approximately 1.5 feet. The existing access road, where the proposed riparian habitat and intermittent stream are located, has an average slope of approximately 5 percent for the first 400 feet and approximately 2 percent for the remaining 1200 feet. Based on the proposed geometry, historical peak flows, and existing slopes, the velocity and shear stress occurring in the creek would likely cause localized erosion and sediment deposition at a downstream location. To reduce the erosion potential of the creek, the maximum proposed slope of the thalweg was limited to 1 percent and achieved by a series of rock drop structures.

The rock drop structures were designed based on the Natural Resources Conservation Service (NRCS) *NEH-654, Stream Restoration Design (2007)*. The maximum drop was set to 3 feet and the majority of the drops are within the range of 1.5 to 2.5 feet. The size of rock for the drop structure was established using the US Army Corp of Engineers Method and Caltrans gradation classifications. The calculations are presented in **Appendix D**.

Based on the proposed channel geometry and maximum slope of 1 percent, **Table 7** presents the maximum velocity and shear stress of the channel assuming the creek is at capacity.

Table 7 – Creek Flow Characteristics

	Minimum Depth (ft)	Flow (cfs)	Velocity (ft/sec)	Shear Stress (lb/ft ²)
Proposed Creek	1.5	44.55	3.96	0.56

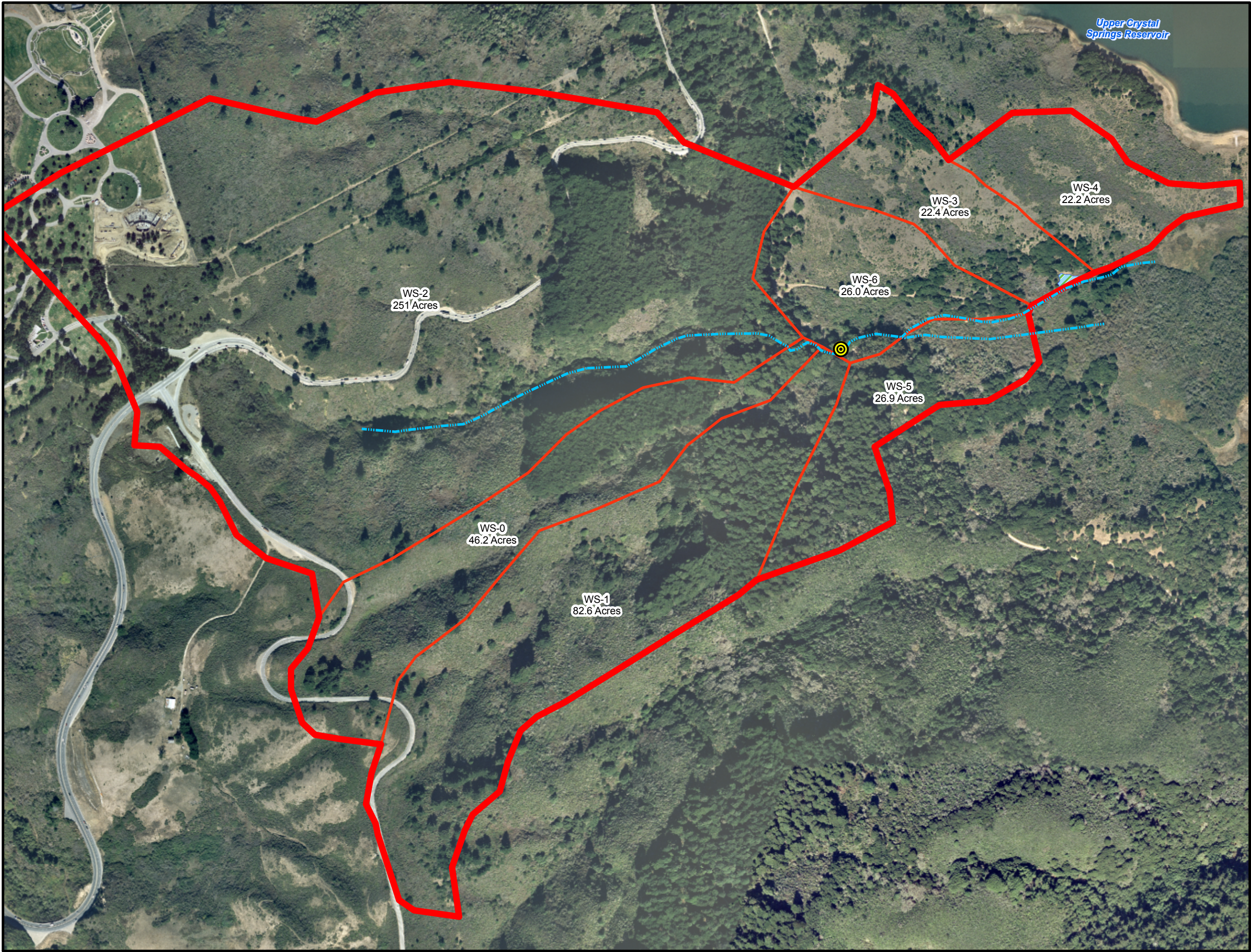
Based on the full flow characteristics of the proposed creek presented in **Table 7**, the proposed vegetation for the riparian habitat will provide more than adequate protection to the creek to prevent erosion. The permissible shear stress for vegetative cover is accepted to be approximately 3 lb/ft², which is well above the calculated shear stress of the channel flowing at capacity. For flows above the capacity of the proposed creek, the erosion potential will be reduced by the shear stress of the floodplain located on both sides of the creek. The floodplains are part of the natural topography of the area and occur predominately on the south side of the proposed creek.

Section 3 Conclusion

Based on the hydrologic analysis and information provided by SFPUC, the watersheds tributary to the proposed wetlands provide sufficient runoff to sustain the wetlands and be provide foraging habitat for California red-legged frogs, and habitat for San Francisco garter snakes, and western pond turtles. Based on calibrated models, the wetlands will be at capacity after the first significant rainfall event and would drain by late spring.

The proposed intermittent creek along the eastern half of the existing access road would provide important habitat for California red-legged frogs, San Francisco garter snake, and San Francisco dusky-footed woodrats. The proposed design conveys the tributary runoff and minimizes erosion and sediment deposition within the creek.

FIGURES



CITY AND COUNTY OF
SAN FRANCISCO
PUBLIC UTILITIES COMMISSION



HABITAT RESERVE PROGRAM
ADOBE GULCH GRASSLANDS
CONTRACT NO. CS-883.D



Legend

- Main Watershed Boundary
- Sub-Watershed Boundary
- Existing Wetland
- Intermittent Stream
- Junction A



0 150 300 600 Feet
1 inch = 600 feet

WATERSHED
DELINEATION
MAP

FIGURE
1



HABITAT RESERVE PROGRAM
ADOBE GULCH GRASSLANDS
CONTRACT NO. CS-883.D



Legend

- Stream Gage
- Piezometer
- Intermittent Stream
- Existing Wetland
- Proposed Wetland
- Project Area
- Old Canada Rd
- Access Rd Converted to Oak Riparian
- Access Rd Converted to Riparian



0 75 150 300 Feet
1 inch = 300 feet

PROJECT AREA
MAP

FIGURE
2



Figure 3 - Adobe Gulch Flow Calibration

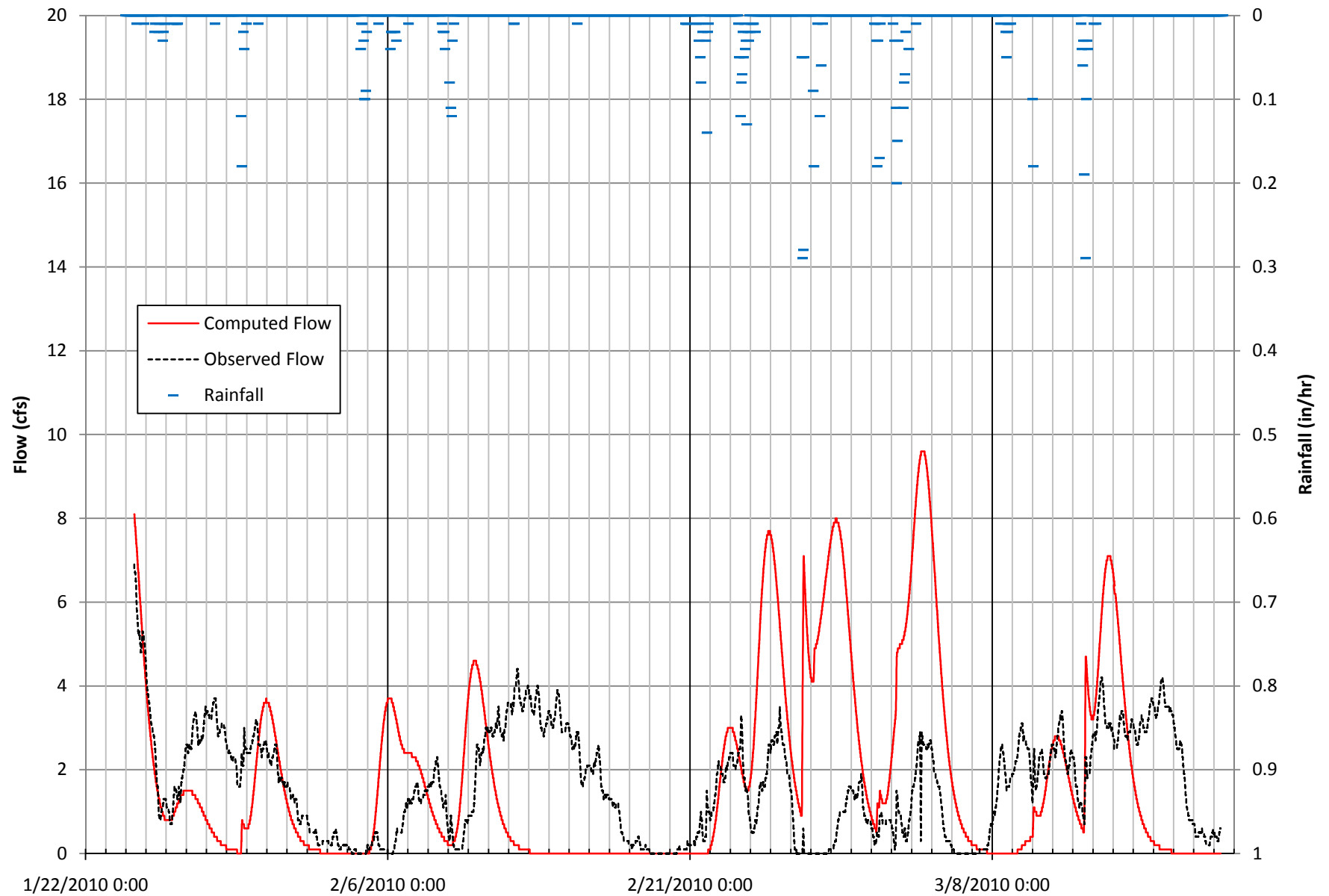
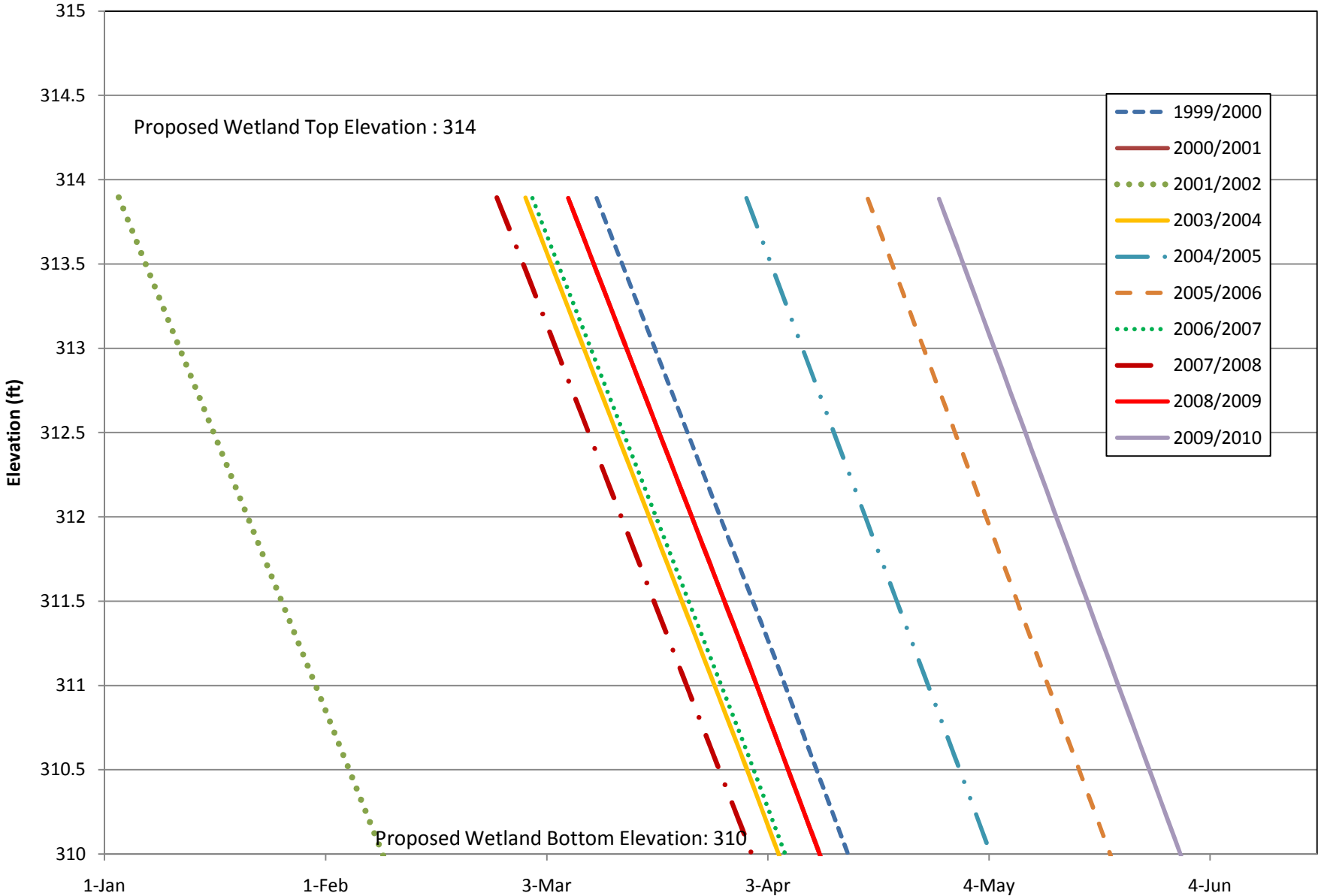


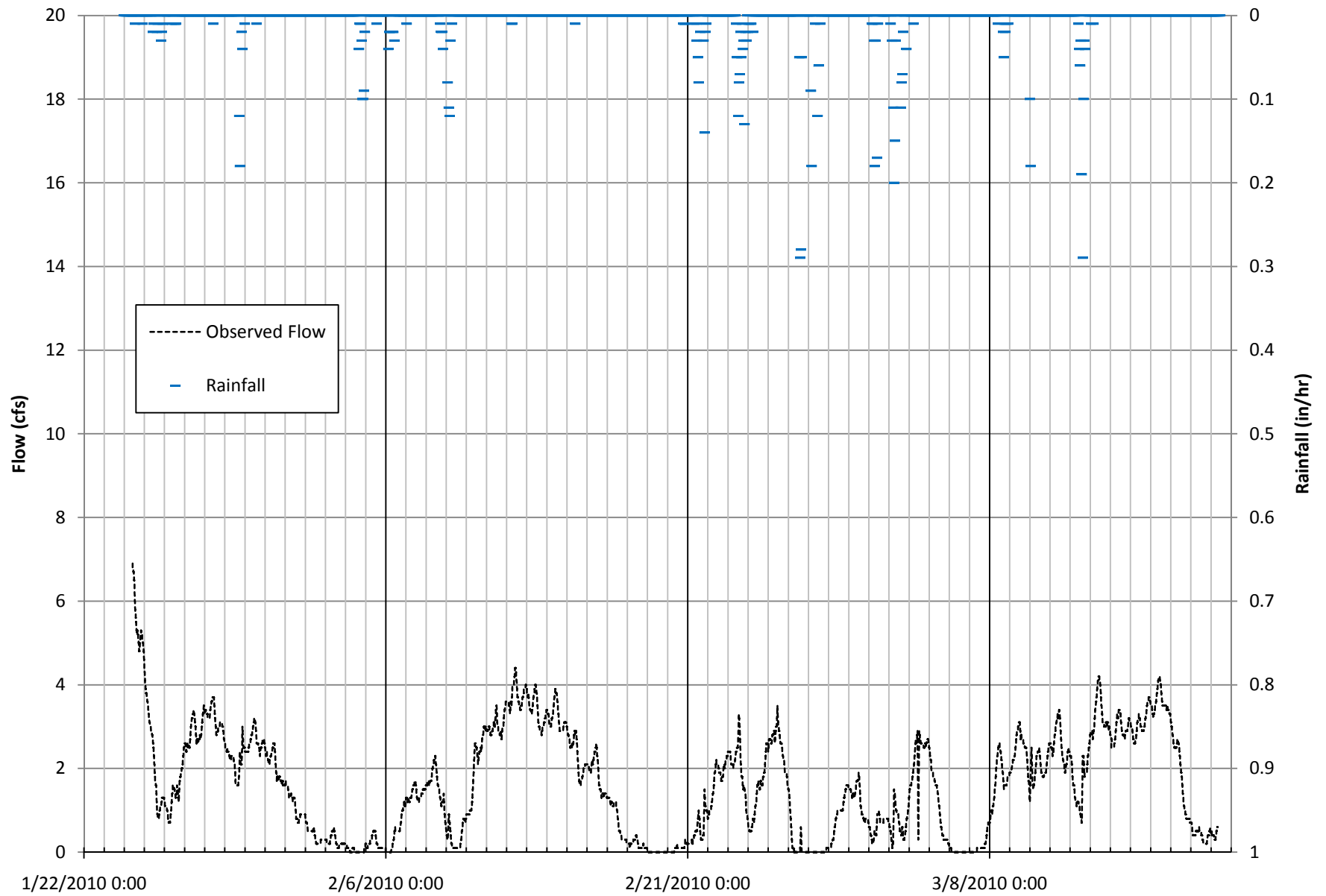
Figure 4 - Proposed Wetland Historical "Dry" Date



APPENDIX A

STREAM, POND & RAINFALL GAGE DATA

Adobe Gulch Stream Gage Data



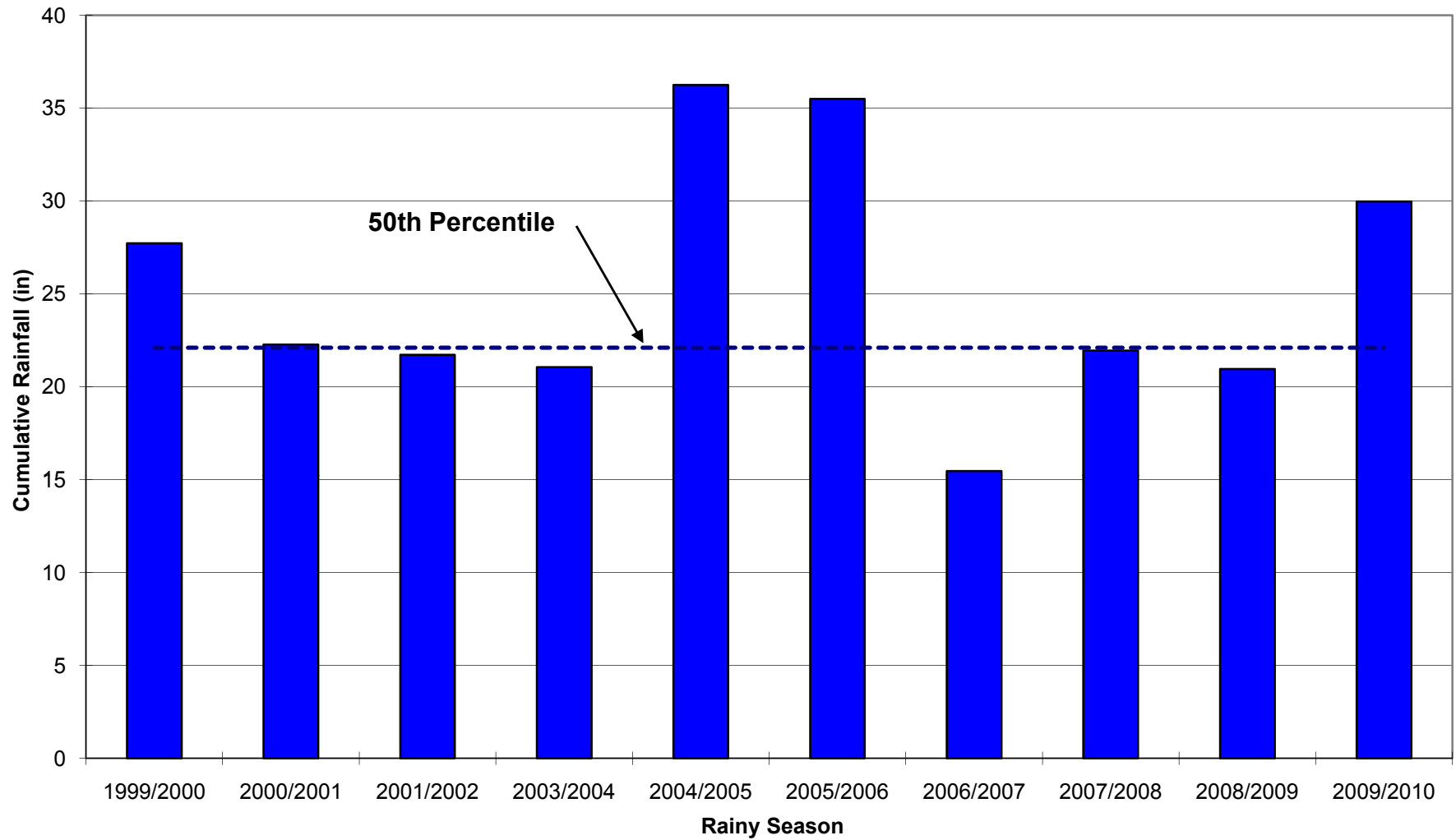
CUMULATIVE RAINFALL SUMMARY

Rainy Season	Cumu	50th Per
1999/2000	27.72	22.105
2000/2001	22.27	22.105
2001/2002	21.72	22.105
2003/2004	21.06	22.105
2004/2005	36.25	22.105
2005/2006	35.5	22.105
2006/2007	15.46	22.105
2007/2008	21.94	22.105
2008/2009	20.96	22.105
2009/2010	29.98	22.105

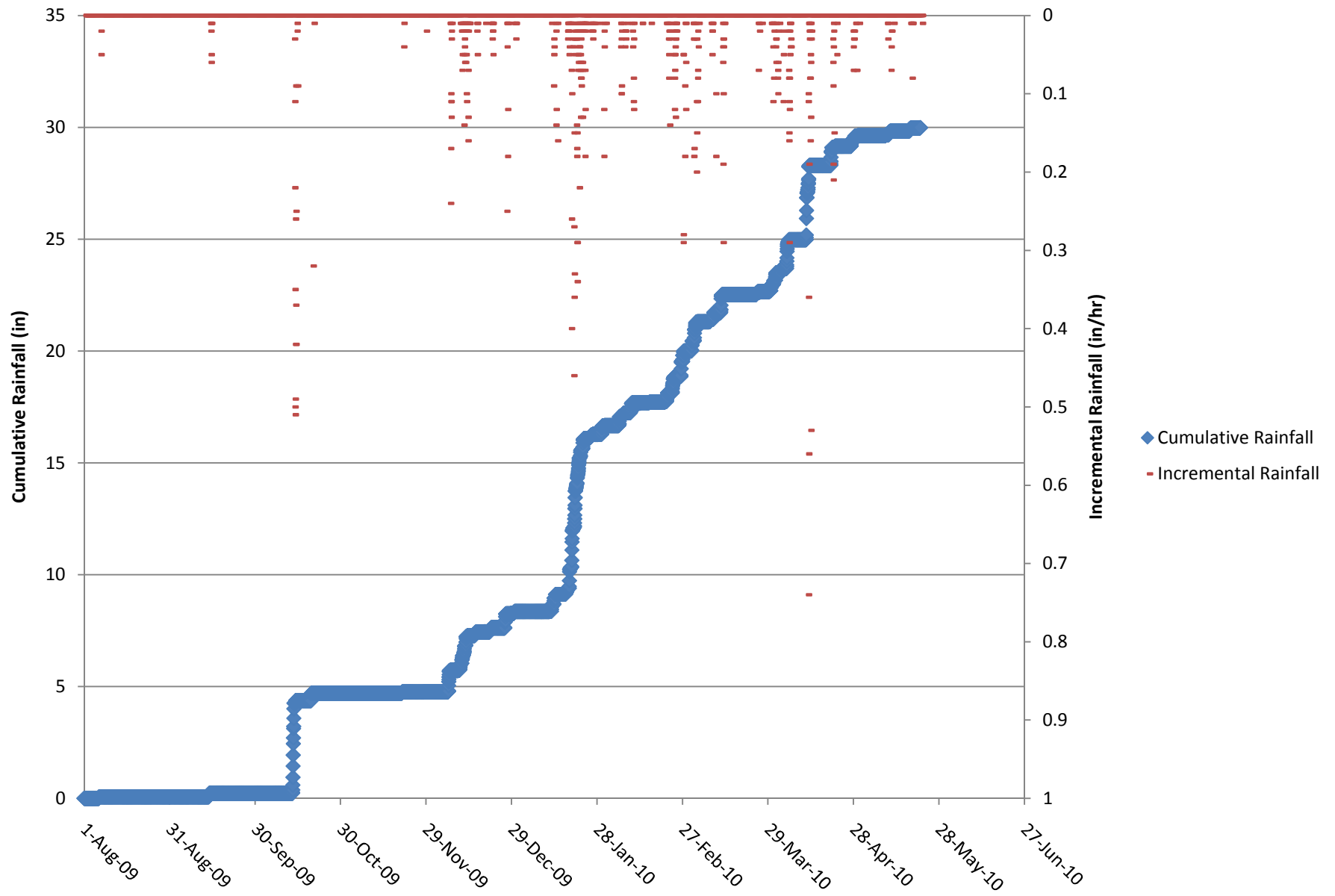
Average: 25.286

Median 22.105

CSC Rain Gage Seasonal Rainfall

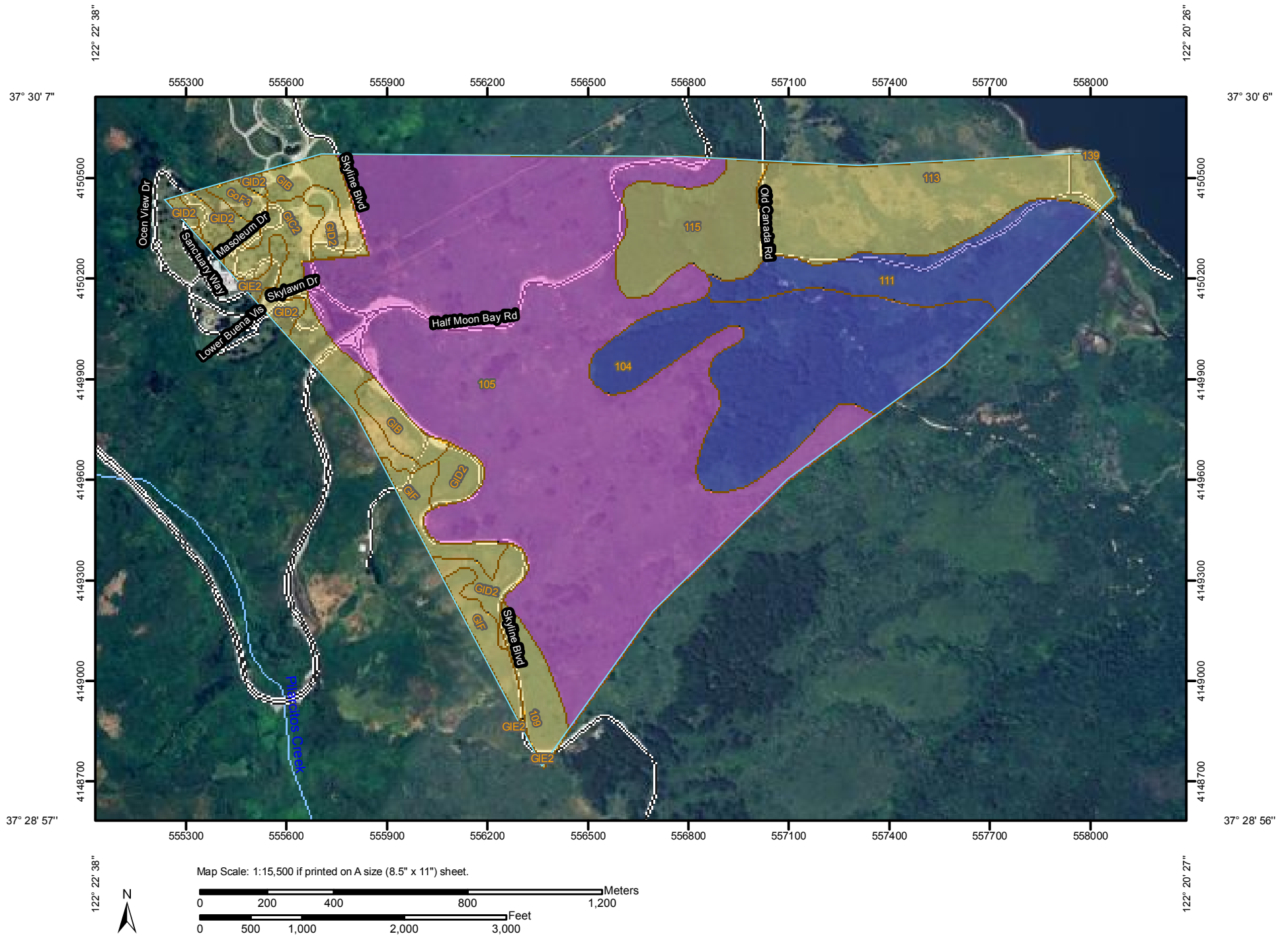


CSC Gage Rainfall 2009/2010



APPENDIX B

NRCS SOIL DATA



MAP LEGEND

Area of Interest (AOI)

 Area of Interest (AOI)

Soils

 Soil Map Units

Soil Ratings

 A

 A/D

 B

 B/D

 C

 C/D

 D

 Not rated or not available

Political Features

 Cities

Water Features

 Oceans

 Streams and Canals

Transportation

 Rails

 Interstate Highways

 US Routes

 Major Roads

 Local Roads

MAP INFORMATION

Map Scale: 1:15,500 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at scales ranging from 1:15,000 to 1:24,000.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: <http://websoilsurvey.nrcs.usda.gov>
Coordinate System: UTM Zone 10N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: San Mateo Area, California
Survey Area Data: Version 5, Sep 10, 2008

Soil Survey Area: San Mateo County, Eastern Part, and San Francisco County, California
Survey Area Data: Version 6, Mar 13, 2008

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area boundaries.

Date(s) aerial images were photographed: 6/12/2005

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — San Mateo Area, California				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
GIB	Gazos-Lobitos silt loams, gently sloping	C	14.8	2.4%
GIC2	Gazos-Lobitos silt loams, sloping, eroded	C	23.8	3.9%
GID2	Gazos-Lobitos silt loams, moderately steep, eroded	C	23.2	3.8%
GIE2	Gazos-Lobitos silt loams, steep, eroded	C	3.3	0.5%
GIF	Gazos-Lobitos silt loams, very steep	C	14.6	2.4%
GoF3	Gazos and Lobitos soils, steep and very steep, severely eroded	C	3.1	0.5%
Subtotals for Soil Survey Area			82.6	13.5%
Totals for Area of Interest			613.8	100.0%

Hydrologic Soil Group— Summary by Map Unit — San Mateo County, Eastern Part, and San Francisco County, California				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
104	Alambique-McGarvey complex, 30 to 75 percent slopes	B	87.2	14.2%
105	Barnabe-Candlestick complex, 30 to 75 percent slopes	D	304.3	49.6%
109	Candlestick-Barnabe complex, 30 to 50 percent slopes	C	10.5	1.7%
111	Candlestick variant loam, 2 to 15 percent slopes	B	39.9	6.5%
113	Fagan loam, 15 to 50 percent slopes	C	57.6	9.4%
115	Los Gatos loam, 30 to 75 percent slopes	C	31.7	5.2%
139	Water		0.0	0.0%
Subtotals for Soil Survey Area			531.2	86.5%
Totals for Area of Interest			613.8	100.0%

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

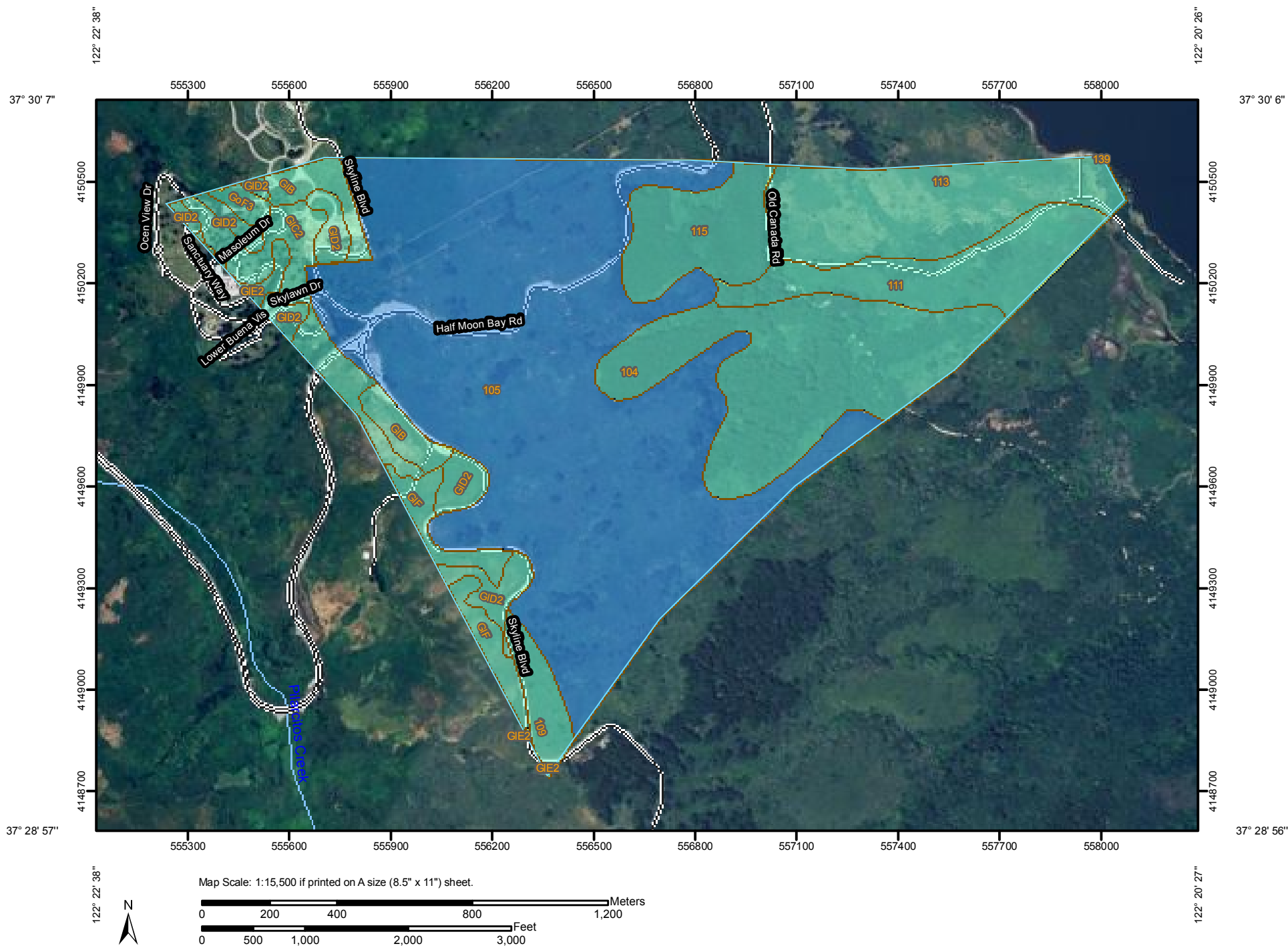
If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Lower



MAP LEGEND

Area of Interest (AOI)

 Area of Interest (AOI)

Soils

 Soil Map Units

Soil Ratings

 Very Low (0.0 - 0.01)

 Low (0.01 - 0.1)

 Moderately Low (0.1 - 1)

 Moderately High (1 - 10)

 High (10 - 100)

 Very High (100 - 705)

 Not rated or not available

Political Features

 Cities

Water Features

 Oceans

 Streams and Canals

Transportation

 Rails

 Interstate Highways

 US Routes

 Major Roads

 Local Roads

MAP INFORMATION

Map Scale: 1:15,500 if printed on A size (8.5" × 11") sheet.

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Date(s) aerial images were photographed: 6/12/2005

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Saturated Hydraulic Conductivity (Ksat), Standard Classes

Saturated Hydraulic Conductivity (Ksat), Standard Classes— Summary by Map Unit — San Mateo Area, California				
Map unit symbol	Map unit name	Rating (micrometers per second)	Acres in AOI	Percent of AOI
GIB	Gazos-Lobitos silt loams, gently sloping	6.4645	14.8	2.4%
GIC2	Gazos-Lobitos silt loams, sloping, eroded	6.2546	23.8	3.9%
GID2	Gazos-Lobitos silt loams, moderately steep, eroded	6.2546	23.2	3.8%
GIE2	Gazos-Lobitos silt loams, steep, eroded	6.2546	3.3	0.5%
GIF	Gazos-Lobitos silt loams, very steep	6.4645	14.6	2.4%
GoF3	Gazos and Lobitos soils, steep and very steep, severely eroded	6.0349	3.1	0.5%
Subtotals for Soil Survey Area			82.6	13.5%
Totals for Area of Interest			613.8	100.0%

Saturated Hydraulic Conductivity (Ksat), Standard Classes— Summary by Map Unit — San Mateo County, Eastern Part, and San Francisco County, California				
Map unit symbol	Map unit name	Rating (micrometers per second)	Acres in AOI	Percent of AOI
104	Alambique-McGarvey complex, 30 to 75 percent slopes	9.0000	87.2	14.2%
105	Barnabe-Candlestick complex, 30 to 75 percent slopes	20.4000	304.3	49.6%
109	Candlestick-Barnabe complex, 30 to 50 percent slopes	7.9672	10.5	1.7%
111	Candlestick variant loam, 2 to 15 percent slopes	4.7236	39.9	6.5%
113	Fagan loam, 15 to 50 percent slopes	2.7452	57.6	9.4%
115	Los Gatos loam, 30 to 75 percent slopes	6.5769	31.7	5.2%
139	Water		0.0	0.0%
Subtotals for Soil Survey Area			531.2	86.5%
Totals for Area of Interest			613.8	100.0%

Description

Saturated hydraulic conductivity (Ksat) refers to the ease with which pores in a saturated soil transmit water. The estimates are expressed in terms of micrometers per second. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Saturated hydraulic conductivity is considered in the design of soil drainage systems and septic tank absorption fields.

For each soil layer, this attribute is actually recorded as three separate values in the database. A low value and a high value indicate the range of this attribute for the soil component. A "representative" value indicates the expected value of this attribute for the component. For this soil property, only the representative value is used.

The numeric Ksat values have been grouped according to standard Ksat class limits. The classes are:

Very low: 0.00 to 0.01

Low: 0.01 to 0.1

Moderately low: 0.1 to 1.0

Moderately high: 1 to 10

High: 10 to 100

Very high: 100 to 705

Rating Options

Units of Measure: micrometers per second

Aggregation Method: Dominant Component

Component Percent Cutoff: None Specified

Tie-break Rule: Fastest

Interpret Nulls as Zero: No

Layer Options: All Layers

[illegible]

MAP LEGEND

Area of Interest (AOI)

 Area of Interest (AOI)

Soils

 Soil Map Units

Soil Ratings

 CH

 CL

 CL-A (proposed)

 CL-K (proposed)

 CL-ML

 CL-O (proposed)

 CL-T (proposed)

 GC

 GC-GM

 GM

 GP

 GP-GC

 GP-GM

 GW

 GW-GC

 GW-GM

 MH

 MH-A (proposed)

 MH-K (proposed)

 MH-O (proposed)

 MH-T (proposed)

 ML

 ML-A (proposed)

 ML-K (proposed)

 ML-O (proposed)

 ML-T (proposed)

 OH

 OH-T (proposed)

 OL

 PT

 SC

 SC-SM

 SM

 SP

 SP-SC

 SP-SM

 SW

 SW-SC

 SW-SM

 Not rated or not available

Political Features

 Cities

Water Features

 Oceans

 Streams and Canals

Transportation

 Rails

 Interstate Highways

 US Routes

 Major Roads

 Local Roads

MAP INFORMATION

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Date(s) aerial images were photographed: 6/12/2005

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Unified Soil Classification (Surface)

Unified Soil Classification (Surface)— Summary by Map Unit — San Mateo Area, California				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
GIB	Gazos-Lobitos silt loams, gently sloping	CL-ML	14.8	2.4%
GIC2	Gazos-Lobitos silt loams, sloping, eroded	CL-ML	23.8	3.9%
GID2	Gazos-Lobitos silt loams, moderately steep, eroded	CL-ML	23.2	3.8%
GIE2	Gazos-Lobitos silt loams, steep, eroded	CL-ML	3.3	0.5%
GIF	Gazos-Lobitos silt loams, very steep	CL-ML	14.6	2.4%
GoF3	Gazos and Lobitos soils, steep and very steep, severely eroded	CL-ML	3.1	0.5%
Subtotals for Soil Survey Area			82.6	13.5%
Totals for Area of Interest			613.8	100.0%

Unified Soil Classification (Surface)— Summary by Map Unit — San Mateo County, Eastern Part, and San Francisco County, California				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
104	Alambique-McGarvey complex, 30 to 75 percent slopes	GC-GM	87.2	14.2%
105	Barnabe-Candlestick complex, 30 to 75 percent slopes	GC-GM	304.3	49.6%
109	Candlestick-Barnabe complex, 30 to 50 percent slopes	SM	10.5	1.7%
111	Candlestick variant loam, 2 to 15 percent slopes	CL-ML	39.9	6.5%
113	Fagan loam, 15 to 50 percent slopes		57.6	9.4%
115	Los Gatos loam, 30 to 75 percent slopes	CL-ML	31.7	5.2%
139	Water		0.0	0.0%
Subtotals for Soil Survey Area			531.2	86.5%
Totals for Area of Interest			613.8	100.0%

Description

The Unified soil classification system classifies mineral and organic mineral soils for engineering purposes on the basis of particle-size characteristics, liquid limit, and plasticity index. It identifies three major soil divisions: (i) coarse-grained soils having less than 50 percent, by weight, particles smaller than 0.074 mm in diameter; (ii) fine-grained soils having 50 percent or more, by weight, particles smaller than 0.074 mm in diameter; and (iii) highly organic soils that demonstrate certain organic characteristics. These divisions are further subdivided into a total of 15 basic soil groups. The major soil divisions and basic soil groups are determined on the basis of estimated or measured values for grain-size distribution and Atterberg limits. ASTM D 2487 shows the criteria chart used for classifying soil in the Unified system and the 15 basic soil groups of the system and the plasticity chart for the Unified system.

The various groupings of this classification correlate in a general way with the engineering behavior of soils. This correlation provides a useful first step in any field or laboratory investigation for engineering purposes. It can serve to make some general interpretations relating to probable performance of the soil for engineering uses.

For each soil horizon in the database one or more Unified soil classifications may be listed. One is marked as the representative or most commonly occurring. The representative classification is shown here for the surface layer of the soil.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Lower

Layer Options: Surface Layer

APPENDIX C CALIBRATION DATA

Evapotranspiration Rates

Month	Evapotranspiration Rate (in/month)
January	1.83
February	2.2
March	3.42
April	4.84
May	5.61
June	6.26
July	6.47
August	6.22
September	4.84
October	3.66
November	2.36
December	1.83

Based on CIMIS Gage #96 in Woodside, CA

Watershed Calibrated Parameters

Watershed	Rainfall Loss Parameters			Hydrograph Convolution Parameters	
	Initial Deficit (in)	Maximum Deficit (in)	Constant Loss Rate (in/hr)	Time of Concentration (hr)	Storage Coefficient (hr)
WS-1	0.75	2.00	0.1500	0.70	10.00
WS-2	0.75	2.00	0.1500	0.47	10.00
WS-3	0.75	2.00	0.1500	0.51	20.00
WS-4	0.75	2.00	0.1500	0.46	10.00

APPENDIX D CREEK DESIGN DATA

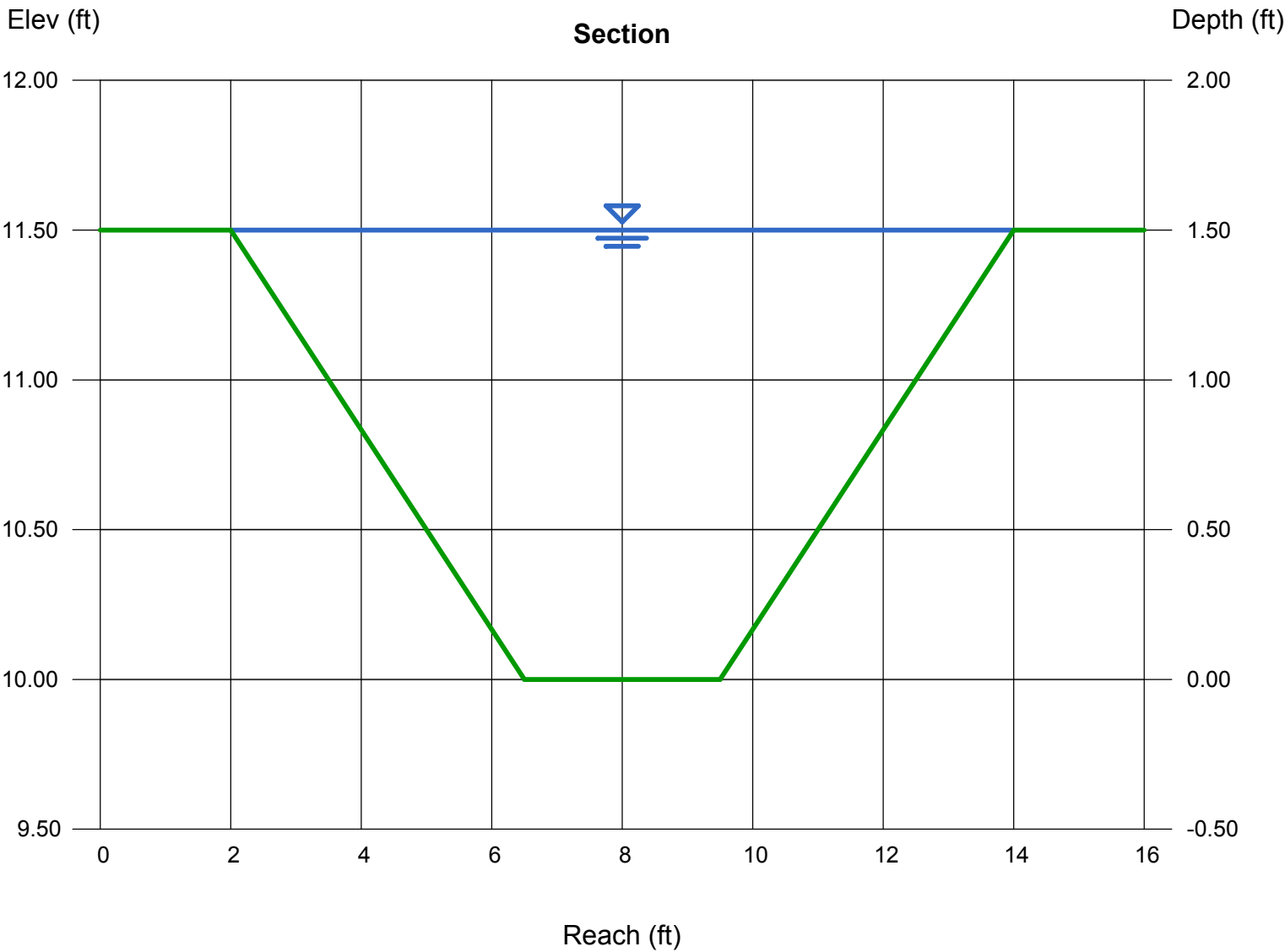
Channel Report

<Name>

Trapezoidal
Bottom Width (ft) = 3.00
Side Slopes (z:1) = 3.00, 3.00
Total Depth (ft) = 1.50
Invert Elev (ft) = 10.00
Slope (%) = 1.00
N-Value = 0.035

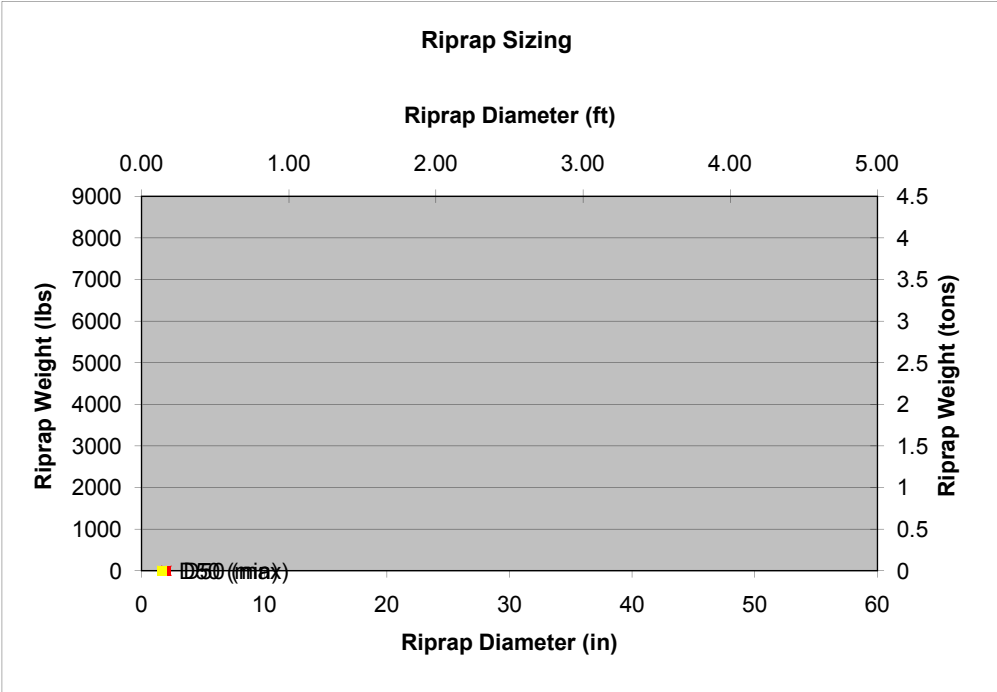
Highlighted
Depth (ft) = 1.50
Q (cfs) = 44.55
Area (sqft) = 11.25
Velocity (ft/s) = 3.96
Wetted Perim (ft) = 12.49
Crit Depth, Yc (ft) = 1.21
Top Width (ft) = 12.00
EGL (ft) = 1.74

Calculations
Compute by: Q vs Depth
No. Increments = 20



Riprap Sizing Using USACE Method

Sf	1.1	
Cs	0.3	
Radius of Bend	1	
Top Width of Water Surface	12	
Cv	1.49883625	
Ct	1	
unit weight of stone	165	
unit weight of water	62.4	
side slope (x:1)	3	18.43494882 degrees
angle of repose for riprap	40	
K1	0.87061607	
Velocity	3.96	
local depth	1.5	
D30	0.11612524	
D85/D15 ration (max)	3	
D85/D15 ration (min)	1.7	
	Diameter (ft)	Diameter (in)
D50 (max)	0.17	2.01
D50 (min)	0.14	1.66
	Weight (lbs)	
		0.31



Appendix E

Reference Sites

Technical Memorandum No. 1
Habitat Reserve Program (HRP) Reference Site Survey Summary

May 20, 2009

INTRODUCTION

The Habitat Reserve Program (HRP) is designed to create, restore or enhance sensitive habitat types that have been impacted by implementation of SFPUC projects. The Project will restore or create the following habitat types: Serpentine Bunchgrass Grassland, Valley Needlegrass Grassland, Semi-permanent Marsh or Pond, Seasonal Wetland, Coast Live Oak Woodland, Mixed Oak Woodland, and Coast Live Oak Riparian Forest.

Initially, NRM Environmental Consulting (NRM) was contracted by Winzler and Kelly to conduct reconnaissance surveys of reference sites in support of the Homestead Pond project. Reference sites were identified by Greg Lyman of the SFPUC, and were provided on a Google Earth Map. Reference sites were chosen that best reflected several of the above mentioned habitats. The present TM is built upon findings included in a memo from NRM dated December 15, 2008, and has been greatly expanded.

With the transition to design for additional HRP sites, a wider range of restoration efforts are now envisioned, and it has become necessary to expand the number of reference sites. The reference sites will be used as a general baseline for the restoration in the Project Areas, particularly to identify habitat structure and dominant or characteristic species. Reference sites are not intended to be tied to mitigation success criteria, although in some cases they may be used to inform decisions as success criteria are formulated. Reference sites were surveyed for dominant vegetation within the tree layer, shrub layer, and understory layer (forbs and grasses).

Native plant species observed at the reference sites, along with information included in a previous vegetation survey (URS, 2004) and other relevant sources, will be used as general guidance for the associated habitat's planting palettes within the Project.

METHODS

Reconnaissance surveys were conducted by NRM on December 12, 2008, when vegetation within the understory layer (grasses and forbs) was predominantly unidentifiable. Many native plants that were identifiable to genus were not identified to species due to the seasonal limitations. After review of the NRM data, Winzler & Kelly conducted more detailed surveys on April 7-9 and May 6-7, 2009. Available regional vegetation surveys in addition to the NRM (2008) data were reviewed, including Schirokauer, et al, (2003), URS (2004) and ESA+Orion (2009). Site vegetation surveys were conducted using the California Native Plant Society Relevé Protocol (CNPS, October 20, 2000, revised April 2004).

RESULTS

A brief summary and representative photo of each reference site follows. Community type nomenclature generally follows Holland (1986). A map of the reference sites is shown in Figure 1, and more detailed information for each site is included in Appendix A

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1. Herbaceous Communities

1.1 Serpentine Bunchgrass

Three serpentine bunchgrass grassland sites were visited. These are described individually below.

S-1 Edgewood Triangle Serpentine Bunchgrass



Serpentine bunchgrass community at Edgewood Triangle

The Edgewood Triangle site is located directly across Cañada Road to the east of Homestead Pond. The site is a west facing slope with a rocky serpentine soil. The dominant and subdominant plants that were discernible included purple needle grass (*Nassella pulchra*), squirrel tail (*Elymus elymoides*), blue wildrye, meadow barley (*Hordeum brachyantherum*), soap plant (*Chloragalum pomeridianum*), blue-eyed grass (*Sisyrinchium bellum*), California plantain (*Plantago erecta*), purple owl's clover (*Castilleja exserta*), California poppy (*Eschscholtzia californica*), common lomatium (*Lomatium utriculatum*), yarrow (*Achillea millefolium*), Ithuriel's spear (*Triteleia laxa*), blue dicks (*Dichelostemma capitatum*), harvest brodiaea (*Brodiaea elegans*), fringed mallow (*Sidalcea diploscypha*), Coast Range false bindweed (*Calystegia collina*), western larkspur (*Delphinium hesperium*), annual dog's tail (*Cynosurus echinatus*), star thistle (*Centaurea solstitialis*), annual cat's ear (*Hypochaeris glabra*), yellow owl's clover (*Orthocarpus luteus*) and hayfield tarweed (*Hemizonia congesta*). This site is an excellent reference site because it is adjacent to Homestead Pond.

S-2 Lower Crystal Springs Boat Ramp Serpentine Bunchgrass



Serpentine bunchgrass community at Lower Crystal Springs boat ramp. Note fountain thistle at left of image.

The Boat Ramp site is located north of Highway 92 and west of Highway 35 near the boat ramp into the Lower Crystal Springs Reservoir. The site is located on a relatively flat area with a gentle west-facing aspect, and few small rock outcrops. Groundwater seepage is evident along the cut bank at the edge of the reservoir. The dominant and subdominant plants that were discernible included purple needle grass, (*Nassella pulchra*), coyote brush (*Baccharis pilularis*), blue wildrye, fountain thistle (*Cirsium fontinale* var. *fontinale*), perennial hair grass (*Deschampsia cespitosa*), soap plant, blue-eyed grass, California plantain, California oat grass, Fremont's death camas (*Zigadenus fremontii*), common lomatium, yarrow, Ithuriel's spear, blue dicks, harvest brodiaea, soft chess, annual cat's ear, yellow owl's clover and hayfield tarweed. Presence of perennial hair grass, Fremont's death camas and fountain thistle suggest elevated groundwater influence at this site.

S-3 Trousdale Serpentine Bunchgrass



Serpentine bunchgrass community adjacent to Trousdale sag pond

A third site, identified here as the Trousdale site after the nearest I-280 exit, is located well to the north, between San Andreas Reservoir and Tracy Lake. This site is in the rift valley at an elevation of approximately 350 feet, and is nearly level to slightly east-facing with scattered small rock outcrops. Dominant and subdominant native species include purple needle grass, (*Nassella pulchra*), Sandberg's bluegrass (*Poa secunda*), blue wildrye, California oatgrass, ookow (*Dichelostemma congesta*), blue-eyed grass, California plantain, meadow barley, coyote mint (*Monardella villosa*), June grass (*Koeleria macrantha*), yarrow, California goldfields (*Baeria californica*), California melic (*Melica californica*), harvest brodiaea, California brome (*Bromus carinatus*), Coast Range false bindweed, naked-stem buckwheat (*Eriogonum nudum*), annual dog's tail, annual cat's ear, yellow owl's clover and hayfield tarweed. Absent are hydrophylls, such as perennial hairgrass due to the lack of elevated groundwater despite the proximity of the adjacent sag pond. The evident species diversity is high possibly due the distance from the nearest roads and frequent disturbance.

1.2 Valley Needlegrass Grassland

One grassland site was visited. For purposes of site design and planting plan preparation, this site was supplemented with data from three other grassland sites in URS (2004).

V-1 Adobe Gulch Coastal Terrace Prairie



Coastal terrace prairie at Adobe Gulch, just east of Old Cañada Road.

One reference site was visited for native bunchgrass grassland. The site includes multiple remnant grassland openings with the Adobe Gulch area, south of Rt. 92 and between Old Cañada Road and Upper Crystal Springs reservoir. ESA (2009) characterized the overall site as coastal terrace prairie, and hypothesized that the area acted as a fog sink and thus encouraged species more characteristic of areas closer to the coast. Two openings, one at each end of the Adobe Grasslands site, were sampled. The openings are relatively small with encroaching scrub habitat. Native cover is approximately 50%, and dominant and subdominant species include purple needle grass, California oatgrass, blue wildrye, blue-eyed grass, Douglas iris (*Iris douglasiana*), Indian paintbrush (*Castilleja affinis*), yarrow, foothill sedge (*Carex tumulicola*), spreading rush (*Juncus patens*), sun-cups (*Camissonia ovata*), six-week fescue (*Vulpia bromoides*), soft chess, perennial cat's ear (*Hypochaeris radicata*), ripgut brome (*Bromus diandrus*), English plantain (*Plantago lanceolata*), bur-clover (*Medicago arabica*), rattlesnake grass (*Bromus brizaeformis*) and annual hairgrass (*Aria caryophyllea*).

2. Wetland Communities

2.1 Coastal and Valley Freshwater Marsh

Three wetlands sites, each representing a different hydrologic regime, were sampled. These are described individually below.

W-1. Trousdale Semi-permanent pond



Semi-permanent wetland at Trousdale sag pond

One semi-permanent pond was visited. This site is located south of San Andreas Reservoir, and west-southwest of the terminus of Trousdale Road at Interstate 280. The pond provides habitat for both California red-legged frog and San Francisco garter snake (K. Swaim, pers. comm., and verified in the field by Winzler & Kelly in April and May of 2009). The pond serves primarily as a hydrological benchmark, and secondarily as a vegetation reference site. The eastern margin of the pond is steep, while the other three margins have a much more gradual slope. Maximum depth is uncertain but is considerably greater than three feet. Dominant and subdominant vegetation includes Baltic rush (*Juncus balticus*), iris-leafed rush (*Juncus xiphioides*), soft rush (*Juncus effusus*), water parsley (*Oenanthe sarmentosa*), common spikerush (*Eleocharis macrostachya*), willow-leaved dock (*Rumex salicifolius*) and penny-royal (*Mentha pulegium*). Species in the upper margin of the wetland include Creeping ryegrass (*Leymus triticoides*), creeping bentgrass (*Agrostis stolonifera*), spreading rush (*Juncus patens*), foothill sedge (*Carex tumulicola*), arroyo willow (*Salix laevigata*) and red willow (*Salix lasiolepis*)

W-2. Old Cañada Road Seasonal Wetland



Seasonal wetland along Old Cañada Road.

One seasonal wetland reference site was visited, a sag pond, located adjacent to Old Cañada Road. The pond was dry in December 2008 and held shallow water (at least six inches deep) in April and May 2009. During a May 6, 2009 site visit, numerous pacific tree frog (*Pseudacris regilla*) tadpoles and some recent metamorphs were observed, documenting successful amphibian recruitment at this wetland. The entire wetland is densely vegetated and is dominated by spikerush (*Eleocharis macrostachys*) and California semaphore grass (*Pleuropogon californica*). The southern boundary is dominated by creeping rush (*Juncus patens*) and the northern boundary is dominated by creeping wildrye (*Leymus triticoides*). The surrounding upland area includes coast live oak to the west and coyote brush to the east.

W-3. Lower Crystal Springs Fringe Wetland



Above: Fringe marsh along Lower Crystal Springs reservoir, near the boat ramp.

A fringe wetland along Lower Crystal Springs Reservoir, located adjacent to the boat ramp, was sampled. This wetland differs in being subjected to potentially more rapid and more extreme fluctuations in water level as the reservoir is drawn down, and in use by large fish. In May 2009 several large carp were observed within this wetland, with an obvious short-term increase in turbidity related to bottom foraging. Dominant and subdominant plants include Common bulrush (*Scirpus acutus*), narrow-leaved cat-tail (*Typha angustifolia*), marsh baccharis (*Baccharis douglasii*), spreading rush (*Juncus patens*), tall flat-sedge (*Cyperus eragrostis*), common rush (*Juncus effusus*), California dock (*Rumex salicifolius*), horseweed (*Conyza canadensis*), creeping bent-grass (*Agrostis stolonifera*) and poison hemlock (*Conium maculatum*).

3. Woodland and Forest Communities

Two oak woodland communities were visited, one dominated by coast live oak, and one mixed oak woodland with coast live oak and valley oak. In addition, two riparian forest sites were characterized. These sites are described below.

3.1 Coast Live Oak Woodland

O-1. Adobe Gulch Coast Live Oak Woodland



Above: Coast live oak woodland at Adobe Gulch

One reference site was visited, located on the west side of Crystal Springs Reservoir, near Adobe Point. It can only be accessed along Old Cañada Road. The site is a long, narrow north-south trending ridge that is forested with a mix of coast live oaks and Pacific madrone. Dominant and subdominant species include coast live oak (*Quercus agrifolia*) and Pacific madrone (*Arbutus menziesii*), Poison oak (*Toxicodendron diversilobum*), toyon (*Heteromeles arbutifolia*), California coffeeberry (*Rhamnus californica*), hillside gooseberry (*Ribes californicum*), and common snowberry (*Symphoricarpos albus*). The understory includes California blackberry (*Rubus californica*), Douglas iris (*Iris douglasiana*), blue wildrye (*Elymus glaucus*), Yerba santa (*Satureja douglasii*), hairy honeysuckle (*Lonicera hispidula*), hound's tongue (*Cynoglossum grande*), Pacific sanicle (*Sanicula crassicaulis*), Pacific starflower (*Trientalis latifolia*) and Indian warrior (*Pedicularis densiflora*).

3.2 Mixed Oak Woodland

O-2. Old Cañada Road Mixed Oak Woodland



Above: Mixed oak woodland near Old Cañada Road

This community is intermediate between the valley oak and coast live oak woodlands described by Holland (1986). One reference site was visited, located west of the Pulgas Water Temple and Laguna Creek. It can only be accessed along Old Cañada Road. This reference site is similar to the mixed oak woodland that is currently found at Homestead Pond. The northern boundary is densely vegetated with a mix of California coffeeberry and coast live oaks. The habitat opens up to the south into an oak savanna with an approximate 60/40 allocation of coast live oaks and valley oaks with a mixed grassland understory. Dominant and subdominant native species include coast live oak (*Quercus agrifolia*) and valley oak (*Quercus lobata*), California coffeeberry (*Rhamnus californica*), poison oak (*Toxicodendron diversilobum*), California buckeye (*Aesculus californica*), blue elderberry (*Sambucus mexicana*), and coyote brush (*Baccharis pilularis*). The understory includes yarrow (*Achillea millefolium*), sanicle (*Sanicula crassicaulis*), man-root (*Marah fabaceus*), blue wildrye (*Elymus glaucus*), bedstraw (*Galium aparine*), hound's tongue (*Cynoglossum grande*), and miner's lettuce (*Claytonia perfoliata*). Non-native and invasive species present include dogtail grass (*Cynosurus echinatus*), oat grass (*Avena barbata*), Italian thistle (*Carduus pycnocephalus*), ripgut brome (*Bromus diandrus*), yellow star-thistle (*Centaurea solstitialis*) and milk thistle (*Silybum marianum*).

3.3 Central Coast Live Oak Riparian Forest

Two riparian reference sites were visited. These are similar in composition, and are lumped for description.



Above: Central Coast live oak riparian forest northwest of Homestead Pond. Note willows in background, along stream channel, with oaks more prevalent away from the active channel.

Site R-1 is located north of the Project Area west of the Filoli Gardens entrance off of Cañada Road. Site R-2 is located just northwest of Homestead Pond. Both sites are densely vegetated and have intermittent streams measuring approximately 10 to 20 feet across (bank to bank) running through the habitat. Dominant and subdominant native species include coast live oak (*Quercus agrifolia*) and arroyo or red willow (*Salix laevigata*, *S. lasiolepis*), Pacific madrone (*Arbutus menziesii*), California bay (*Umbellularia californica*), Poison oak (*Toxicodendron diversilobum*), California coffeeberry (*Rhamnus californica*), toyon (*Heteromeles arbutifolia*), and coyote brush (*Baccharis pilularis*). The understory includes California blackberry (*Rubus californica*), Douglas iris (*Iris douglasiana*), blue wildrye (*Elymus glaucus*), Yerba santa (*Satureja douglasii*), hairy honeysuckle (*Lonicera hispidula*), mugwort (*Artemisia douglasiana*), and spreading rush (*Juncus patens*). The sites are similar to HRP project sites in location, species makeup, hydrology, and elevation.

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- URS Corporation. 2004. Vegetation Survey of the Peninsula and Alameda Watersheds (Task 6) Agreement No. CS-699E

Appendix F: Plant Species Composition of Serpentine Bunchgrass Sites

<u>Genus</u>	<u>Species</u>	<u>Variety</u>	<u>Family</u>	<u>Common Name</u>	<u>Native</u>	<u>Site S-1</u>	<u>Site S-2</u>	<u>Site S-3</u>
<i>Achillea</i>	<i>millefolium</i>		<i>Asteraceae</i>	yarrow	Native	5		1
<i>Agoseris</i>	<i>heterophylla</i>		<i>Asteraceae</i>	annual agoseris	Introduced	1		
<i>Agrostis</i>	<i>microphylla</i>		<i>Poaceae</i>	small leaf bunchgrass	Native	1		
<i>Aira</i>	<i>caryophylla</i>		<i>Poaceae</i>	silver hairgrass	Introduced	2	2	1
<i>Anagallis</i>	<i>arvensis</i>		<i>Primulaceae</i>	scarlet pimpernel	Introduced		1	
<i>Aphanes</i>	<i>occidentalis</i>		<i>Rosaceae</i>	field parsley	Native	1		
<i>Arabis</i>	<i>blepharophylla</i>		<i>Brassicaceae</i>	rose rockcress	Native	1		
<i>Avena</i>	<i>fatua</i>		<i>Poaceae</i>	wild oat	Introduced		1	1
<i>Baccharis</i>	<i>pilularis</i>		<i>Asteraceae</i>	coyote brush	Native		5	1
<i>Brodiaea</i>	<i>terrestris</i>		<i>Liliaceae</i>	dwarf clusterlily	Native		1	
<i>Bromus</i>	<i>carinatus</i>		<i>Poaceae</i>	California brome	Native	3	2	3
<i>Bromus</i>	<i>diandrus</i>		<i>Poaceae</i>	ripgut brome	Introduced			
<i>Bromus</i>	<i>hordeaceus</i>		<i>Poaceae</i>	soft chess	Introduced	3	2	1
<i>Calandrinia</i>	<i>ciliata</i>		<i>Portulacaceae</i>	red maids	Native		1	
<i>Calystegia</i>	<i>subcaulis</i>		<i>Convolvulaceae</i>	hillside false bindweed	Native	5		1
<i>Castilleja</i>	<i>densiflora</i>		<i>Scrophulariaceae</i>	denseflower owl's-clover	Native	1	1	
<i>Castilleja</i>	<i>rubicundula</i>	<i>lithospermoides</i>	<i>Scrophulariaceae</i>	cream sacs	Native	2		
<i>Centaurea</i>	<i>solstitialis</i>		<i>Asteraceae</i>	yellow star thistle	Introduced	3		
<i>Centaureum</i>	<i>muehlenbergii</i>		<i>Gentianaceae</i>	Muhlenberg's centaury	Native		1	
<i>Chlorogalum</i>	<i>pomeridianum</i>		<i>Liliaceae</i>	soaproot	Native		5	1
<i>Cirsium</i>	<i>fontinale</i>	<i>fontinale</i>	<i>Asteraceae</i>	fountain thistle	Native		2	
<i>Clarkia</i>	<i>purpurea</i>	<i>quadrivulnera</i>	<i>Onagraceae</i>	winecup fairyfan	Native	2		1
<i>Clarkia</i>	<i>rubicunda</i>	<i>rubicunda</i>	<i>Onagraceae</i>	ruby chalice clarkia	Native			
<i>Crassula</i>	<i>connata</i>		<i>Crassulaceae</i>	pygmy-weed	Native		1	1
<i>Cuscuta</i>	<i>californica</i>		<i>Cuscutaceae</i>	chaparral dodder	Native	2		
<i>Danthonia</i>	<i>californica</i>		<i>Poaceae</i>	California oatgrass	Native	5	7	3
<i>Daucus</i>	<i>pusillus</i>		<i>Apiaceae</i>	American wild carrot	Native	1	1	
<i>Delphinium</i>	<i>hesperium</i>	<i>hesperium</i>	<i>Ranunculaceae</i>	foothill larkspur	Native	1	2	
<i>Deschampsia</i>	<i>cespitosa</i>	<i>cespitosa</i>	<i>Poaceae</i>	tufted hairgrass	Native		5	
<i>Deschampsia</i>	<i>danthonioides</i>		<i>Poaceae</i>	annual hairgrass	Native	1		1
<i>Dichelostemma</i>	<i>capitatum</i>		<i>Liliaceae</i>	blue dicks	Native	1	1	
<i>Dichelostemma</i>	<i>congestum</i>		<i>Liliaceae</i>	ookow	Native			2
<i>Elymus</i>	<i>glaucus</i>		<i>Poaceae</i>	blue wildrye	Native	1	1	5
<i>Elymus</i>	<i>multisetus</i>		<i>Poaceae</i>	big squirreltail	Native	3		

Appendix F: Plant Species Composition of Serpentine Bunchgrass Sites

<u>Genus</u>	<u>Species</u>	<u>Variety</u>	<u>Family</u>	<u>Common Name</u>	<u>Native</u>	<u>Site S-1</u>	<u>Site S-2</u>	<u>Site S-3</u>
<i>Epilobium</i>	<i>brachycarpum</i>		<i>Onagraceae</i>	autumn willowweed	Native	1	1	1
<i>Eriogonum</i>	<i>nudum</i>		<i>Polygonaceae</i>	naked buckwheat	Native	2	1	5
<i>Eschscholzia</i>	<i>californica</i>		<i>Papaveraceae</i>	California poppy	Native	3	1	1
<i>Euphorbia</i>	<i>pelus</i>		<i>Euphobiaceae</i>	petty spurge	Introduced			1
<i>Festuca</i>	<i>rubra</i>		<i>Poaceae</i>	red fescue	Introduced	5	2	
<i>Gastridium</i>	<i>ventricosum</i>		<i>Poaceae</i>	nit grass	Introduced	1		
<i>Grindelia</i>	<i>camporum</i>		<i>Asteraceae</i>	Great Valley gumweed	Native	1	1	
<i>Hemizonia</i>	<i>congesta</i>	<i>luzulifolia</i>	<i>Asteraceae</i>	hayfield tarweed	Native	5		
<i>Hordeum</i>	<i>brachyantherum</i>		<i>Poaceae</i>	meadow barley	Native	5		
<i>Hypochaeris</i>	<i>glabra</i>		<i>Asteraceae</i>	smooth cat's ear	Introduced	3	1	1
<i>Koeleria</i>	<i>macrantha</i>		<i>Poaceae</i>	junegrass	Native	1	1	3
<i>Lactuca</i>	<i>saligna</i>		<i>Asteraceae</i>	slender leaf lettuce	Introduced	1	1	
<i>Lasthenia</i>	<i>californica</i>		<i>Asteraceae</i>	common goldfields	Native	5	2	5
<i>Layia</i>	<i>platyglossa</i>		<i>Asteraceae</i>	tidy-tips	Native	1		
<i>Lolium</i>	<i>multiflorum</i>		<i>Poaceae</i>	Italian ryegrass	Introduced	2		5
<i>Lomatium</i>	<i>utriculatum</i>		<i>Apiaceae</i>	common lomatium	Native	2	5	1
<i>Lotus</i>	<i>humistratus</i>		<i>Fabaceae</i>	foothill deervetch	Native		1	
<i>Lotus</i>	<i>wrangelianus</i>		<i>Fabaceae</i>	Chilean trefoil	Native	1	1	
<i>Lupinus</i>	<i>bicolor</i>		<i>Fabaceae</i>	bicolor lupine	Native	1		
<i>Melica</i>	<i>californica</i>		<i>Poaceae</i>	California melic	Native	1		5
<i>Mimulus</i>	<i>guttatus</i>		<i>Scrophulariaceae</i>	seep monkeyflower	Native		1	
<i>Monardella</i>	<i>villosa</i>		<i>Lamiaceae</i>	coyote mint	Native			2
<i>Nassella</i>	<i>lepida</i>		<i>Poaceae</i>	foothill needlegrass	Native	1		
<i>Nassella</i>	<i>pulchra</i>		<i>Poaceae</i>	purple needlegrass	Native	10	5	5
<i>Phacelia</i>	<i>californica</i>		<i>Hydrophyllaceae</i>	California scorpionweed	Native	2		
<i>Plantago</i>	<i>erecta</i>		<i>Plantaginaceae</i>	rock plantago	Native	5	2	
<i>Poa</i>	<i>secunda</i>		<i>Poaceae</i>	one-sided bluegrass	Native	1	1	5
<i>Pteridium</i>	<i>aquilinum</i>	<i>pubescens</i>	<i>Dennstaedtiaceae</i>	bracken fern	Native	1		
<i>Ranunculus</i>	<i>californicus</i>	<i>californicus</i>	<i>Ranunculaceae</i>	California buttercup	Native			1
<i>Rumex</i>	<i>acetosella</i>		<i>Polygonaceae</i>	common sheep sorrel	Introduced	2	1	
<i>Sanicula</i>	<i>bipinnatifida</i>		<i>Apiaceae</i>	purple sanicle	Native		1	
<i>Scrophularia</i>	<i>californica</i>		<i>Scrophulariaceae</i>	California figwort	Native			1
<i>Sidalcea</i>	<i>diploscypha</i>		<i>Malvaceae</i>	fringed checkermallow	Native	3	1	1
<i>Silene</i>	<i>gallica</i>		<i>Caryophyllaceae</i>	common catchfly	Introduced	1	1	
<i>Sisyrinchium</i>	<i>bellum</i>		<i>Iridaceae</i>	western blue-eyed grass	Native	3	1	1

Appendix F: Plant Species Composition of Serpentine Bunchgrass Sites

<u>Genus</u>	<u>Species</u>	<u>Variety</u>	<u>Family</u>	<u>Common Name</u>	<u>Native</u>	<u>Site S-1</u>	<u>Site S-2</u>	<u>Site S-3</u>
<i>Sonchus</i>	<i>asper</i>		<i>Asteraceae</i>	spiny sowthistle	Introduced			1
<i>Toxicodendron</i>	<i>diversilobum</i>		<i>Anacardiaceae</i>	pacific poison oak	Native	1		1
<i>Trifolium</i>	<i>albopurpureum</i>	<i>dichotomum</i>	<i>Fabaceae</i>	branched Indian clover	Native		1	
<i>Trifolium</i>	<i>ciliolatum</i>		<i>Fabaceae</i>	foothill clover	Native		1	
<i>Trifolium</i>	<i>microdon</i>		<i>Fabaceae</i>	thimble clover	Native	1	1	1
<i>Trifolium</i>	<i>variegatum</i>		<i>Fabaceae</i>	variegated clover	Native	1		
<i>Trifolium</i>	<i>willdenovii</i>		<i>Fabaceae</i>	tomcat clover	Native	1		
<i>Triteleia</i>	<i>hyacinthina</i>		<i>Liliaceae</i>	white brodiaea	Native	2		
<i>Triteleia</i>	<i>laxa</i>		<i>Liliaceae</i>	Ithuriel's spear	Native	3		1
<i>Vulpia</i>	<i>bromoides</i>		<i>Poaceae</i>	brome fescue	Introduced	2	2	5
<i>Vulpia</i>	<i>microstachys</i>	<i>pauciflora</i>	<i>Poaceae</i>	pacific fescue	Native	2	2	1
<i>Vulpia</i>	<i>myuros</i>	<i>hirsuta</i>	<i>Poaceae</i>	rattail fescue	Introduced		2	
<i>Zigadenus</i>	<i>fremontii</i>		<i>Liliaceae</i>	Fremont's death camas	Native		2	

The % cover is given for plant species found in each site.

Appendix F: Plant Species Composition of Valley Needlegrass Grassland Sites

<u>Genus</u>	<u>Species</u>	<u>Variety</u>	<u>Family</u>	<u>Common Name</u>	<u>Native</u>	<u>Site V-1</u>
<i>Acaena</i>	<i>pinnafida</i>	<i>californica</i>	<i>Rosaceae</i>	sheepburr	Native	1
<i>Achillea</i>	<i>millefolium</i>		<i>Asteraceae</i>	yarrow	Native	5
<i>Agoseris</i>	<i>grandiflora</i>		<i>Asteraceae</i>	bigflower agoseris	Native	1
<i>Aira</i>	<i>caryophylla</i>		<i>Poaceae</i>	silver hairgrass	Introduced	2
<i>Anagallis</i>	<i>arvensis</i>		<i>Primulaceae</i>	scarlet pimpernel	Introduced	1
<i>Aster</i>	<i>chilensis</i>		<i>Asteraceae</i>	creeping aster	Native	1
<i>Aster</i>	<i>radulinus</i>		<i>Asteraceae</i>	roughleaf aster	Native	1
<i>Avena</i>	<i>barbata</i>		<i>Poaceae</i>	slender oat	Introduced	1
<i>Avena</i>	<i>fatua</i>		<i>Poaceae</i>	wild oat	Introduced	5
<i>Baccharis</i>	<i>pilularis</i>		<i>Asteraceae</i>	coyote brush	Native	1
<i>Berberis</i>	<i>sp.</i>		<i>Berberidaceae</i>	barberry	Native	1
<i>Brachypodium</i>	<i>distachyon</i>		<i>Poaceae</i>	purple false brome	Introduced	1
<i>Briza</i>	<i>minor</i>		<i>Poaceae</i>	small quaking grass	Introduced	1
<i>Brodiaea</i>	<i>terrestris</i>		<i>Liliaceae</i>	dwarf clusterlily	Native	1
<i>Bromus</i>	<i>brizaeformis</i>		<i>Poaceae</i>	rattlesnake grass	Introduced	4
<i>Bromus</i>	<i>carinatus</i>		<i>Poaceae</i>	California brome	Native	2
<i>Bromus</i>	<i>diandrus</i>		<i>Poaceae</i>	riggut brome	Introduced	5
<i>Bromus</i>	<i>hordeaceus</i>		<i>Poaceae</i>	soft chess	Introduced	7
<i>Calystegia</i>	<i>subacaulis</i>		<i>Convolvulaceae</i>	hillside false bindweed	Native	1
<i>Camissonia</i>	<i>ovata</i>		<i>Onagraceae</i>	sun-cups	Native	2
<i>Carduus</i>	<i>pycnocephalus</i>		<i>Asteraceae</i>	Italian plumeless thistle	Introduced	2
<i>Carex</i>	<i>tumulicola</i>		<i>Cyperaceae</i>	foothill sedge	Native	3
<i>Castilleja</i>	<i>affinis</i>		<i>Scrophulariaceae</i>	Indian paintbrush	Native	3
<i>Centaurea</i>	<i>melitensis</i>		<i>Asteraceae</i>	totalote	Introduced	1
<i>Cerastium</i>	<i>glomeratum</i>		<i>Caryophyllaceae</i>	sticky chickweed	Introduced	1
<i>Chlorogalum</i>	<i>pomeridianum</i>		<i>Liliaceae</i>	soaproot	Native	1
<i>Cynosurus</i>	<i>echinatus</i>		<i>Poaceae</i>	annual dogtail	Introduced	1
<i>Danthonia</i>	<i>californica</i>		<i>Poaceae</i>	California oatgrass	Native	10
<i>Daucus</i>	<i>pusillus</i>		<i>Apiaceae</i>	American wild carrot	Native	1
<i>Dichelostemma</i>	<i>congestum</i>		<i>Liliaceae</i>	fork-toothed ookow	Native	1
<i>Elymus</i>	<i>elymoides</i>		<i>Poaceae</i>	squirreltail	Native	5
<i>Elymus</i>	<i>glaucus</i>		<i>Poaceae</i>	blue wildrye	Native	7
<i>Epilobium</i>	<i>brachycarpum</i>		<i>Onagraceae</i>	autumn willowherb	Native	1
<i>Epilobium</i>	<i>sp.</i>		<i>Onagraceae</i>	fireweed	Native	1

Appendix F: Plant Species Composition of Valley Needlegrass Grassland Sites

<u>Genus</u>	<u>Species</u>	<u>Variety</u>	<u>Family</u>	<u>Common Name</u>	<u>Native</u>	<u>Site V-1</u>
<i>Eriogonum</i>	<i>nudum</i>		<i>Polygonaceae</i>	naked buckwheat	Native	1
<i>Erodium</i>	<i>brachycarpum</i>		<i>Geraniaceae</i>	shortfruit stork's bill	Introduced	1
<i>Erodium</i>	<i>cicutarium</i>		<i>Geraniaceae</i>	cranesbill	Introduced	1
<i>Erodium</i>	<i>moschatum</i>		<i>Geraniaceae</i>	musky stork's bill	Introduced	1
<i>Eschscholzia</i>	<i>californica</i>		<i>Papaveraceae</i>	California poppy	Native	1
<i>Euphorbia</i>	<i>pelus</i>		<i>Euphobiaceae</i>	petty spurge	Introduced	1
<i>Festuca</i>	<i>rubra</i>		<i>Poaceae</i>	red fescue	Introduced	1
<i>Filago</i>	<i>gallica</i>		<i>Asteraceae</i>	narrow-leaved filago	Introduced	1
<i>Galium</i>	<i>parisiense</i>		<i>Rubiaceae</i>	wall bedstraw	Introduced	1
<i>Gastridium</i>	<i>ventricosum</i>		<i>Poaceae</i>	nit grass	Introduced	1
<i>Geranium</i>	<i>dissectum</i>		<i>Geraniaceae</i>	cutleaf geranium	Introduced	1
<i>Grindelia</i>	<i>sp.</i>		<i>Asteraceae</i>	gumweed	Native	1
<i>Hordeum</i>	<i>brachyantherum</i>		<i>Poaceae</i>	meadow barley	Native	1
<i>Hordeum</i>	<i>jubatum</i>		<i>Poaceae</i>	foxtail barley	Introduced	1
<i>Hypochaeris</i>	<i>glabra</i>		<i>Asteraceae</i>	smooth cat's ear	Introduced	1
<i>Hypochaeris</i>	<i>radicata</i>		<i>Asteraceae</i>	rough cat's ear	Introduced	5
<i>Iris</i>	<i>douglasiana</i>		<i>Iridaceae</i>	Douglas iris	Native	2
<i>Juncus</i>	<i>patens</i>		<i>Juncaceae</i>	spreading rush	Native	3
<i>Koeleria</i>	<i>macrantha</i>		<i>Poaceae</i>	junegrass	Native	1
<i>Linum</i>	<i>bienne</i>		<i>Linaceae</i>	flax	Introduced	1
<i>Lolium</i>	<i>multiflorum</i>		<i>Poaceae</i>	Italian ryegrass	Introduced	2
<i>Lomatium</i>	<i>dasy carpum</i>		<i>Apiaceae</i>	woollyfruit desert parsley	Native	1
<i>Lonicera</i>	<i>hispidula</i>	<i>vacillans</i>	<i>Caprifoliaceae</i>	pink honeysuckle	Native	1
<i>Lotus</i>	<i>humistratus</i>		<i>Fabaceae</i>	foothill deervetch	Native	1
<i>Lotus</i>	<i>wrangelianus</i>		<i>Fabaceae</i>	Chilean trefoil	Native	1
<i>Lupinus</i>	<i>formosus</i>		<i>Fabaceae</i>	western lupine	Native	1
<i>Lupinus</i>	<i>sp.</i>		<i>Fabaceae</i>	lupine	Native	1
<i>Luzula</i>	<i>comosa</i>		<i>Juncaceae</i>	hairy woodrush	Native	1
<i>Luzula</i>	<i>sp.</i>		<i>Juncaceae</i>	woodrush	Native	1
<i>Madia</i>	<i>gracilis</i>		<i>Asteraceae</i>	slender tarweed	Native	2
<i>Madia</i>	<i>sativa</i>		<i>Asteraceae</i>	coast tarweed	Native	1
<i>Marah</i>	<i>sp.</i>		<i>Cucurbitaceae</i>	manroot	Native	1
<i>Medicago</i>	<i>arabica</i>		<i>Fabaceae</i>	bur-clover	Introduced	5
<i>Micropus</i>	<i>sp.</i>		<i>Asteraceae</i>	cotton seed	Native	1
<i>Monardella</i>	<i>villosa</i>		<i>Lamiaceae</i>	coyote mint	Native	1

Appendix F: Plant Species Composition of Valley Needlegrass Grassland Sites

<u>Genus</u>	<u>Species</u>	<u>Variety</u>	<u>Family</u>	<u>Common Name</u>	<u>Native</u>	<u>Site V-1</u>
<i>Nassella</i>	<i>lepida</i>		<i>Poaceae</i>	foothill needlegrass	Native	1
<i>Nassella</i>	<i>pulchra</i>		<i>Poaceae</i>	purple needlegrass	Native	15
<i>Perideridia</i>	<i>kelloggii</i>		<i>Apiaceae</i>	Kellogg's yampah	Native	1
<i>Plantago</i>	<i>erecta</i>		<i>Plantaginaceae</i>	rock plantago	Native	2
<i>Plantago</i>	<i>lanceolata</i>		<i>Plantaginaceae</i>	English plantain	Introduced	4
<i>Ranunculus</i>	<i>sp.</i>		<i>Ranunculaceae</i>	buttercup	Native	1
<i>Rhamnus</i>	<i>californica</i>		<i>Rhamnaceae</i>	coffeeberry	Native	1
<i>Ribes</i>	<i>aureum</i>		<i>Grossulariaceae</i>	golden currant	Native	1
<i>Ribes</i>	<i>sp.</i>		<i>Grossulariaceae</i>	gooseberry	Native	1
<i>Rubus</i>	<i>ursinus</i>		<i>Rosaceae</i>	California blackberry	Native	1
<i>Rumex</i>	<i>acetosella</i>		<i>Polygonaceae</i>	sheep sorrel	Introduced	1
<i>Sanicula</i>	<i>arctopoides</i>		<i>Apiaceae</i>	footsteps of spring	Native	1
<i>Sanicula</i>	<i>bipinnatifida</i>		<i>Apiaceae</i>	purple sanicle	Native	1
<i>Satureja</i>	<i>douglasii</i>		<i>Lamiaceae</i>	yerba buena	Native	1
<i>Sherardia</i>	<i>arvensis</i>		<i>Rubiaceae</i>	field madder	Introduced	1
<i>Sidalcea</i>	<i>malvaeflora</i>		<i>Malvaceae</i>	checker mallow	Native	1
<i>Silene</i>	<i>gallica</i>		<i>Caryophyllaceae</i>	common catchfly	Introduced	1
<i>Sisyrinchium</i>	<i>bellum</i>		<i>Iridaceae</i>	blue-eyed grass	Native	5
<i>Sonchus</i>	<i>asper</i>		<i>Asteraceae</i>	spiny sowthistle	Introduced	1
<i>Stachys</i>	<i>ajugoides</i>	<i>rigida</i>	<i>Lamiaceae</i>	rigid hedge-nettle	Native	1
<i>Torilis</i>	<i>arvensis</i>		<i>Apiaceae</i>	spreading hedge parsley	Introduced	1
<i>Torilis</i>	<i>nodosa</i>		<i>Apiaceae</i>	knotted hedge parsley	Introduced	1
<i>Toxicodendron</i>	<i>diversilobum</i>		<i>Anacardiaceae</i>	poison oak	Native	2
<i>Trifolium</i>	<i>dubium</i>		<i>Fabaceae</i>	shamrock	Introduced	3
<i>Trifolium</i>	<i>macraei</i>		<i>Fabaceae</i>	Chilean clover	Native	1
<i>Trifolium</i>	<i>microdon</i>		<i>Fabaceae</i>	thimble clover	Native	1
<i>Trifolium</i>	<i>sp.</i>		<i>Fabaceae</i>	clover	Introduced	1
<i>Trillium</i>	<i>sp.</i>		<i>Liliaceae</i>	trillium	Native	1
<i>Triteleia</i>	<i>laxa</i>		<i>Liliaceae</i>	Ithuriel's spear	Native	1
<i>Triteleia</i>	<i>sp.</i>		<i>Lilliaceae</i>	triteleia	Native	1
<i>Vicia</i>	<i>sativa</i>	<i>sativa</i>	<i>Fabaceae</i>	common vetch	Introduced	1
<i>Vicia</i>	<i>sp.</i>		<i>Fabaceae</i>	vetch	Introduced	1
<i>Vulpia</i>	<i>bromoides</i>		<i>Poaceae</i>	brome fescue	Introduced	2
<i>Vulpia</i>	<i>microstachys</i>	<i>pauciflora</i>	<i>Poaceae</i>	pacific fescue	Native	1
<i>Vulpia</i>	<i>myuros</i>	<i>hirsuta</i>	<i>Poaceae</i>	rattail fescue	Introduced	1

Appendix F: Plant Species Composition of Valley Needlegrass Grassland Sites

<u>Genus</u>	<u>Species</u>	<u>Variety</u>	<u>Family</u>	<u>Common Name</u>	<u>Native</u>	<u>Site V-1</u>
<i>Wyethia</i>	<i>angustifolia</i>		<i>Asteraceae</i>	California compassplant	Native	1
<i>Yabea</i>	<i>microcarpa</i>		<i>Apiaceae</i>	falsecarrot	Native	1
<i>Zigadenus</i>	<i>fremontii</i>		<i>Liliaceae</i>	Fremont's death camas	Native	1

The % cover class is provided for each plant species.

Appendix F: Plant Species Composition of Freshwater Marsh Sites

<u>Genus</u>	<u>Species</u>	<u>Variety</u>	<u>Family</u>	<u>Common Name</u>	<u>Native</u>	<u>Site W-1</u>	<u>Site W-2</u>	<u>Site W-3</u>
<i>Achillea</i>	<i>millefolium</i>		<i>Asteraceae</i>	yarrow	Native	2	4	5
<i>Agrostis</i>	<i>stolonifera</i>		<i>Poaceae</i>	creeping bent grass	Introduced	10		3
<i>Baccharis</i>	<i>douglasii</i>		<i>Asteraceae</i>	saltmarsh baccharis	Native		5	10
<i>Carex</i>	<i>bolanderi</i>		<i>Cyperaceae</i>	Bolander's sedge	Native	1		
<i>Carex</i>	<i>tumulicola</i>		<i>Cyperaceae</i>	splitawn sedge	Native	5		
<i>Cirsium</i>	<i>vulgare</i>		<i>Asteraceae</i>	bull thistle	Introduced	1	1	
<i>Conium</i>	<i>maculatum</i>		<i>Apiaceae</i>	poison hemlock	Introduced			5
<i>Conyza</i>	<i>canadensis</i>		<i>Asteraceae</i>	horseweed	Native			3
<i>Cyperus</i>	<i>eragrostis</i>		<i>Cyperaceae</i>	tall flatsedge	Native	2	2	10
<i>Deschampsia</i>	<i>cespitosa</i>	<i>cespitosa</i>	<i>Poaceae</i>	tufted hairgrass	Native	5	1	
<i>Deschampsia</i>	<i>danthonioides</i>		<i>Poaceae</i>	annual hairgrass	Native			2
<i>Eleocharis</i>	<i>macrostachya</i>		<i>Cyperaceae</i>	spikerush	Native	10		1
<i>Epilobium</i>	<i>ciliatum</i>		<i>Onagraceae</i>	hairy willowherb	Native			1
<i>Geranium</i>	<i>dissectum</i>		<i>Geraniaceae</i>	cutleaf geranium	Introduced	1		
<i>Holcus</i>	<i>lanatus</i>		<i>Poaceae</i>	common velvetgrass	Introduced	5		5
<i>Hordeum</i>	<i>brachyantherum</i>		<i>Poaceae</i>	meadow barley	Native	1	1	
<i>Hordeum</i>	<i>murinum</i>		<i>Poaceae</i>	Mediterranean barley	Introduced			1
<i>Hypericum</i>	<i>anagalloides</i>		<i>Hypericaceae</i>	tinker's penny	Native	1		
<i>Hypochaeris</i>	<i>radicata</i>		<i>Asteraceae</i>	rough cat's ear	Introduced	1		
<i>Juncus</i>	<i>balticus</i>		<i>Juncaceae</i>	Baltic rush	Native	5		
<i>Juncus</i>	<i>effusus</i>		<i>Juncaceae</i>	soft rush	Native		1	
<i>Juncus</i>	<i>xiphoides</i>		<i>Juncaceae</i>	iris-leafed rush	Native	5		
<i>Juncus</i>	<i>patens</i>		<i>Juncaceae</i>	spreading rush	Native	1	2	
<i>Leymus</i>	<i>triticoides</i>		<i>Poaceae</i>	creeping ryegrass	Native	5		
<i>Lolium</i>	<i>perenne</i>		<i>Poaceae</i>	perennial ryegrass	Introduced			1
<i>Lotus</i>	<i>corniculatus</i>		<i>Fabaceae</i>	birdfoot deervetch	Introduced	2		1
<i>Lythrum</i>	<i>hyssopifolium</i>		<i>Lythraceae</i>	loosestrife	Introduced	1		1
<i>Mentha</i>	<i>pulegium</i>		<i>Lamiaceae</i>	pennyroyal	Introduced			1
<i>Mentha</i>	<i>arvensis</i>		<i>Lamiaceae</i>	wild mint	Native	1		
<i>Mimulus</i>	<i>guttatus</i>		<i>Scrophulariaceae</i>	seep monkeyflower	Native	1		
<i>Oenanthe</i>	<i>sarmentosa</i>		<i>Apiaceae</i>	water parsley	Native	10		
<i>Picris</i>	<i>echioides</i>		<i>Asteraceae</i>	bristly ox-tongue	Introduced	5		
<i>Pleuropogon</i>	<i>californica</i>		<i>Poaceae</i>	California semaphore grass	Native		10	
<i>Polygonum</i>	<i>puncatatum</i>		<i>Polygonaceae</i>	dotted smartweed	Native		1	1
<i>Polypogon</i>	<i>maritimus</i>		<i>Poaceae</i>	rabbitsfoot grass	Introduced			1
<i>Pyrrocoma</i>	<i>racemosa</i>		<i>Asteraceae</i>	golden fleece	Native	5	3	10

Appendix F: Plant Species Composition of Freshwater Marsh Sites

<u>Genus</u>	<u>Species</u>	<u>Variety</u>	<u>Family</u>	<u>Common Name</u>	<u>Native</u>	<u>Site W-1</u>	<u>Site W-2</u>	<u>Site W-3</u>
<i>Ribes</i>	<i>divaricatum</i>		<i>Grossulariaceae</i>	coastal black gooseberry	Native		1	
<i>Rorippa</i>	<i>curvisiliqua</i>		<i>Brassicaceae</i>	curvepod yellowcress	Native			1
<i>Rubus</i>	<i>ursinus</i>		<i>Rosaceae</i>	California blackberry	Native		1	
<i>Rumex</i>	<i>conglomeratus</i>		<i>Polygonaceae</i>	clustered dock	Introduced	1		
<i>Rumex</i>	<i>crispus</i>		<i>Polygonaceae</i>	curly dock	Introduced			1
<i>Rumex</i>	<i>salicifolius</i>		<i>Polygonaceae</i>	willow dock	Native	10	5	10
<i>Salix</i>	<i>laevigata</i>		<i>Salicaceae</i>	arroyo willow	Native	10		
<i>Salix</i>	<i>lasiolepis</i>		<i>Salicaceae</i>	red willow	Native	10		
<i>Scirpus</i>	<i>acutus</i>		<i>Cyperaceae</i>	hardstem bulrush	Native			10
<i>Senecio</i>	<i>hydrophilus</i>		<i>Asteraceae</i>	water ragwort	Native		1	
<i>Sonchus</i>	<i>asper</i>		<i>Asteraceae</i>	spiny sowthistle	Introduced	1		
<i>Stachys</i>	<i>ajugoides</i>		<i>Lamiaceae</i>	Ajuga hedge nettle	Native	5		
<i>Trifolium</i>	<i>wormskioldii</i>		<i>Fabaceae</i>	cow clover	Native	1		
<i>Typha</i>	<i>angustifolia</i>		<i>Typhaceae</i>	narrow-leaved cattail	Native			5
<i>Typha</i>	<i>latifolia</i>		<i>Typhaceae</i>	broad-leaved cattail	Native	2	2	3
<i>Veronica</i>	<i>peregrina</i>		<i>Scrophulariaceae</i>	hairy purslane speedwell	Native			2
<i>Vicia</i>	<i>sativa</i>		<i>Fabaceae</i>	common vetch	Introduced	1		
<i>Xanthium</i>	<i>strumarium</i>		<i>Asteraceae</i>	cocklebur	Native			1

The % cover class is provided for each plant species at each site.

Appendix F: Plant Species Composition of Coast Live Oak Woodland Sites

<u>Genus</u>	<u>Species</u>	<u>Variety</u>	<u>Family</u>	<u>Common Name</u>	<u>Native</u>	<u>Site O-1</u>	<u>Site O-2</u>
<i>Adiantum</i>	<i>jordanii</i>		<i>Pteridaceae</i>	California maiden-hair	Native	1	1
<i>Agrostis</i>	<i>pallens</i>		<i>Poaceae</i>	seashore bentgrass	Native	1	1
<i>Aira</i>	<i>caryophyllea</i>		<i>Poaceae</i>	silver hairgrass	Introduced	1	1
<i>Anagallis</i>	<i>arvensis</i>		<i>Primulaceae</i>	scarlet pimpernel	Introduced	1	1
<i>Arbutus</i>	<i>menziesii</i>		<i>Ericaceae</i>	madrone	Native	15	15
<i>Artemisia</i>	<i>douglasiana</i>		<i>Asteraceae</i>	Douglas' sagewort	Native	1	1
<i>Avena</i>	<i>fatua</i>		<i>Poaceae</i>	wild oat	Introduced	2	10
<i>Baccharis</i>	<i>pilularis</i>		<i>Asteraceae</i>	coyote brush	Native	5	10
<i>Barbarea</i>	<i>orthoceras</i>		<i>Brassicaceae</i>	American yellowrocket	Native	1	1
<i>Brachypodium</i>	<i>distachyon</i>		<i>Poaceae</i>	purple false brome	Introduced	1	1
<i>Bromus</i>	<i>carinatus</i>		<i>Poaceae</i>	California brome	Native	1	1
<i>Bromus</i>	<i>diandrus</i>		<i>Poaceae</i>	ripgut brome	Introduced	2	10
<i>Calystegia</i>	<i>subacaulis</i>		<i>Convolvulaceae</i>	hillside false bindweed	Native	1	1
<i>Carduus</i>	<i>pycncephalus</i>		<i>Asteraceae</i>	Italian plumeless thistle	Introduced	1	10
<i>Centaurea</i>	<i>solstitialis</i>		<i>Asteraceae</i>	yellow star thistle	Introduced		10
<i>Centaureium</i>	<i>muehlenbergii</i>		<i>Gentianaceae</i>	Muhlenberg's centaury	Native	1	1
<i>Chlorogalum</i>	<i>pomeridianum</i>		<i>Liliaceae</i>	soaproot	Native	1	1
<i>Cirsium</i>	<i>vulgare</i>		<i>Asteraceae</i>	bull thistle	Introduced	1	1
<i>Claytonia</i>	<i>perfoliata</i>		<i>Portulacaceae</i>	miner's lettuce	Native	5	10
<i>Cynoglossum</i>	<i>grande</i>		<i>Boraginaceae</i>	hound's tongue	Native	10	10
<i>Cynosurus</i>	<i>echinatus</i>		<i>Poaceae</i>	annual dogtail	Introduced	1	1
<i>Dryopteris</i>	<i>arguta</i>		<i>Dryopteridaceae</i>	coastal woodfern	Native	1	1
<i>Elymus</i>	<i>glaucus</i>		<i>Poaceae</i>	blue wildrye	Native	10	10
<i>Epilobium</i>	<i>densiflorum</i>		<i>Onagraceae</i>	denseflower spike primrose	Native	1	1
<i>Epipactis</i>	<i>helleborine</i>		<i>Orchidaceae</i>	helleborine	Introduced	1	1
<i>Galium</i>	<i>aparine</i>		<i>Rubiaceae</i>	bedstraw	Introduced	5	10
<i>Galium</i>	<i>triflorum</i>		<i>Rubiaceae</i>	fragrant bedstraw	Native	1	1
<i>Gnaphthium</i>	<i>californicum</i>		<i>Asteraceae</i>	ladies' tobacco	Native	1	1
<i>Heracleum</i>	<i>lanatum</i>		<i>Apiaceae</i>	common cowparsnip	Native	1	1
<i>Heteromeles</i>	<i>arbutifolia</i>		<i>Rosaceae</i>	toyon	Native	10	10
<i>Hypochaeris</i>	<i>radicata</i>		<i>Asteraceae</i>	rough cat's ear	Introduced	1	1
<i>Iris</i>	<i>douglasiana</i>		<i>Iridaceae</i>	Douglas' iris	Native	5	10
<i>Juncus</i>	<i>dubius</i>		<i>Juncaceae</i>	dubius rush	Native	1	1
<i>Lolium</i>	<i>multiflorum</i>		<i>Poaceae</i>	Italian ryegrass	Introduced	5	1

Appendix F: Plant Species Composition of Coast Live Oak Woodland Sites

<u>Genus</u>	<u>Species</u>	<u>Variety</u>	<u>Family</u>	<u>Common Name</u>	<u>Native</u>	<u>Site O-1</u>	<u>Site O-2</u>
<i>Lonicera</i>	<i>hispidula</i>		<i>Caprifoliaceae</i>	pink honeysuckle	Native	10	10
<i>Lotus</i>	<i>purshianus</i>		<i>Fabaceae</i>	Spanish clover	Native	1	1
<i>Luzula</i>	<i>comosa</i>		<i>Juncaceae</i>	hairy woodrush	Native	1	1
<i>Lythrum</i>	<i>hyssopifolium</i>		<i>Lythraceae</i>	loosestrife	Introduced	1	1
<i>Madia</i>	<i>exigua</i>		<i>Asteraceae</i>	threadstem tarweed	Native	1	1
<i>Marah</i>	<i>sp.</i>		<i>Cucurbitaceae</i>	manroot	Native	1	1
<i>Melica</i>	<i>torreyana</i>		<i>Poaceae</i>	melicgrass	Native	2	2
<i>Monardella</i>	<i>villosa</i>		<i>Lamiaceae</i>	coyote mint	Native	1	1
<i>Myosotis</i>	<i>sp.</i>		<i>Boraginaceae</i>	forget-me-not	Introduced	1	1
<i>Navarretia</i>	<i>mellita</i>		<i>Polemoniaceae</i>	skunk navarretia	Native	1	1
<i>Pedicularis</i>	<i>densiflora</i>		<i>Scrophulariaceae</i>	Indian warrior	Native	10	15
<i>Pentagramma</i>	<i>triangularis</i>		<i>Pteridaceae</i>	gold fern	Native	1	1
<i>Phalaris</i>	<i>aquatica</i>		<i>Poaceae</i>	Harding grass	Introduced	1	1
<i>Physocarpus</i>	<i>capitatus</i>		<i>Rosaceae</i>	Pacific ninebark	Native	1	1
<i>Picris</i>	<i>echioides</i>		<i>Asteraceae</i>	bristly ox-tongue	Introduced	1	1
<i>Plantago</i>	<i>erecta</i>		<i>Plantaginaceae</i>	rock plantago	Native	1	1
<i>Plantago</i>	<i>lanceolata</i>		<i>Plantaginaceae</i>	narrowleaf plantain	Introduced	1	1
<i>Polystichum</i>	<i>munitum</i>		<i>Dryopteridaceae</i>	wester swordfern	Native	1	1
<i>Prunus</i>	<i>sp.</i>		<i>Rosaceae</i>	wild cherry	Native	1	1
<i>Quercus</i>	<i>agrifolia</i>		<i>Fagaceae</i>	coast live oak	Native	30	30
<i>Quercus</i>	<i>lobata</i>		<i>Fagaceae</i>	valley oak	Native		15
<i>Rhamnus</i>	<i>californica</i>		<i>Rhamnaceae</i>	coffeeberry	Native	1	1
<i>Ribes</i>	<i>californicum</i>		<i>Grossulariaceae</i>	hillside gooseberry	Native	5	2
<i>Rosa</i>	<i>californica</i>		<i>Rosaceae</i>	California wildrose	Native	1	1
<i>Rosa</i>	<i>gymnocarpa</i>		<i>Rosaceae</i>	dwarf rose	Native	1	1
<i>Rubus</i>	<i>ursinus</i>		<i>Rosaceae</i>	California blackberry	Native	20	25
<i>Sambucus</i>	<i>mexicana</i>		<i>Caprifoliaceae</i>	blue elder	Native	5	10
<i>Sanicula</i>	<i>crassicaulis</i>		<i>Apiaceae</i>	pacific blacksnakeroot	Native	1	1
<i>Satureja</i>	<i>douglasii</i>		<i>Lamiaceae</i>	yerba buena	Native	5	10
<i>Silybum</i>	<i>marianum</i>		<i>Asteraceae</i>	milk thistle	Introduced		10
<i>Sonchus</i>	<i>asper</i>		<i>Asteraceae</i>	spiny sowthistle	Introduced	1	1
<i>Stellaria</i>	<i>media</i>		<i>Caryophyllaceae</i>	common chickweed	Introduced	1	1
<i>Symphoricarpos</i>	<i>albus</i>		<i>Caprifoliaceae</i>	common snowberry	Native	5	5
<i>Thalictrum</i>	<i>sp.</i>		<i>Ranunculaceae</i>	meadow rue	Native	1	1
<i>Torilis</i>	<i>arvensis</i>		<i>Apiaceae</i>	spreading hedge parsley	Introduced	1	1

Appendix F: Plant Species Composition of Coast Live Oak Woodland Sites

<u>Genus</u>	<u>Species</u>	<u>Variety</u>	<u>Family</u>	<u>Common Name</u>	<u>Native</u>	<u>Site O-1</u>	<u>Site O-2</u>
<i>Toxicodendron</i>	<i>diversilobum</i>		<i>Anacardiaceae</i>	pacific poison oak	Native	15	20
<i>Trientalis</i>	<i>latifolium</i>		<i>Primulaceae</i>	Pacific starflower	Native	5	5
<i>Umbellularia</i>	<i>californica</i>		<i>Lauraceae</i>	California laurel	Native	2	2
<i>Veronica</i>	<i>americana</i>		<i>Scrophulariaceae</i>	American speedwell	Native	1	1
<i>Vicia</i>	<i>americana</i>	<i>americana</i>	<i>Fabaceae</i>	American vetch	Native	1	1
<i>Vicia</i>	<i>sativa</i>	<i>sativa</i>	<i>Fabaceae</i>	common vetch	Introduced	1	1

The % cover is provided for plant species found in each site.

Appendix F: Plant Species Composition of Central Coast Live Oak Riparian Forest Sites

<u>Genus</u>	<u>Species</u>	<u>Variety</u>	<u>Family</u>	<u>Common Name</u>	<u>Native</u>	<u>Site R-1</u>
<i>Adiantum</i>	<i>jordanii</i>		<i>Pteridaceae</i>	California maiden-hair	Native	2
<i>Aquilegia</i>	<i>formosa</i>		<i>Ranunculaceae</i>	western columbine	Native	1
<i>Arbutus</i>	<i>menziesii</i>		<i>Ericaceae</i>	Pacific madrone	Native	5
<i>Artemisia</i>	<i>douglasiana</i>		<i>Asteraceae</i>	Douglas' sagewort	Native	10
<i>Athyrium</i>	<i>filix-femina</i>		<i>Dryopteridaceae</i>	common ladyfern	Native	1
<i>Baccharis</i>	<i>pilularis</i>		<i>Asteraceae</i>	coyote brush	Native	5
<i>Bromus</i>	<i>laevipes</i>		<i>Poaceae</i>	Chinook brome	Native	1
<i>Cardamine</i>	<i>californica</i>		<i>Brassicaceae</i>	milkmaids	Native	1
<i>Carex</i>	<i>sp.</i>		<i>Cyperaceae</i>	sedge	Native	1
<i>Corylus</i>	<i>cornuta</i>		<i>Betulaceae</i>	hazelnut	Native	2
<i>Dicentra</i>	<i>formosa</i>		<i>Papaveraceae</i>	Pacific bleedingheart	Native	
<i>Disporum</i>	<i>smithii</i>		<i>Liliaceae</i>	large flower fairybells	Native	2
<i>Dryopteris</i>	<i>arguta</i>		<i>Dryopteridaceae</i>	coastal woodfern	Native	1
<i>Elymus</i>	<i>glaucus</i>		<i>Poaceae</i>	blue wildrye	Native	10
<i>Epilobium</i>	<i>sp.</i>		<i>Onagraceae</i>	fireweed	Native	1
<i>Equisetum</i>	<i>telmateia</i>		<i>Equisetaceae</i>	giant horsetail	Native	2
<i>Galium</i>	<i>aparine</i>		<i>Rubiaceae</i>	common bedstraw	Native	5
<i>Galium</i>	<i>triflorum</i>		<i>Rubiaceae</i>	fragrant bedstraw	Native	2
<i>Galium</i>	<i>sp.</i>		<i>Rubiaceae</i>	bedstraw	Native	1
<i>Heracleum</i>	<i>lanatum</i>		<i>Apiaceae</i>	cowparsnip	Native	5
<i>Heteromeles</i>	<i>arbutifolia</i>		<i>Rosaceae</i>	toyon	Native	5
<i>Heuchera</i>	<i>sp.</i>		<i>Saxifragaceae</i>	alumroot	Native	1
<i>Juncus</i>	<i>patens</i>		<i>Juncaceae</i>	spreading rush	Native	10
<i>Lonicera</i>	<i>hispidula</i>		<i>Caprifoliaceae</i>	hairy honeysuckle	Native	1
<i>Madia</i>	<i>madioides</i>		<i>Asteraceae</i>	woodland madia	Native	1
<i>Marah</i>	<i>oreganus</i>		<i>Cucurbitaceae</i>	coast man-root	Native	5
<i>Melica</i>	<i>torreyana</i>		<i>Poaceae</i>	Torrey's melicgrass	Native	1
<i>Mimulus</i>	<i>guttatus</i>		<i>Scrophulariaceae</i>	seep monkeyflower	Native	1
<i>Oenanthe</i>	<i>sarmentosa</i>		<i>Apiaceae</i>	water parsely	Native	2
<i>Osmorhiza</i>	<i>sp.</i>		<i>Apiaceae</i>	sweetroot	Native	1
<i>Oxalis</i>	<i>oregana</i>		<i>Oxalidaceae</i>	redwood sorrel	Native	2
<i>Pentagramma</i>	<i>triangularis</i>		<i>Pteridaceae</i>	gold fern	Native	1
<i>Polypodium</i>	<i>californicum</i>		<i>Polypodiaceae</i>	California polypody	Native	1
<i>Polystichum</i>	<i>munitum</i>		<i>Dryopteridaceae</i>	wester swordfern	Native	2

Appendix F: Plant Species Composition of Central Coast Live Oak Riparian Forest Sites

<u>Genus</u>	<u>Species</u>	<u>Variety</u>	<u>Family</u>	<u>Common Name</u>	<u>Native</u>	<u>Site R-1</u>
<i>Pseudotsuga</i>	<i>menziesii</i>		<i>Pinaceae</i>	Douglas fir	Native	1
<i>Quercus</i>	<i>agrifolia</i>		<i>Fagaceae</i>	coast live oak	Native	25
<i>Rhamnus</i>	<i>californica</i>		<i>Rhamnaceae</i>	coffeeberry	Native	5
<i>Rubus</i>	<i>parviflorus</i>		<i>Rosaceae</i>	thimbleberry	Native	2
<i>Rubus</i>	<i>ursinus</i>		<i>Rosaceae</i>	California blackberry	Native	2
<i>Salix</i>	<i>laevigata</i>		<i>Salicaceae</i>	arroyo willow	Native	5
<i>Salix</i>	<i>lasiolepis</i>		<i>Salicaceae</i>	red willow	Native	10
<i>Sambucus</i>	<i>racemosa</i>		<i>Caprifoliaceae</i>	scarlet elderberry	Native	2
<i>Sanicula</i>	<i>crassicaulis</i>		<i>Apiaceae</i>	pacific blacksnakeroot	Native	1
<i>Scoliopus</i>	<i>bigelovii</i>		<i>Liliaceae</i>	California fetid adderstongue	Native	1
<i>Scrophularia</i>	<i>californica</i>		<i>Scrophulariaceae</i>	California figwort	Native	1
<i>Smilacina</i>	<i>stellata</i>		<i>Liliaceae</i>	little false solomon's seal	Native	2
<i>Solanum</i>	<i>sp.</i>		<i>Solanaceae</i>	nightshade	Native	
<i>Stachys</i>	<i>chamissonis</i>		<i>Lamiaceae</i>	coast hedge nettle	Native	5
<i>Stachys</i>	<i>sp.</i>		<i>Lamiaceae</i>	hedgenettle	Introduced	1
<i>Stellaria</i>	<i>media</i>		<i>Caryophyllaceae</i>	common chickweed	Introduced	1
<i>Symphoricarpos</i>	<i>albus</i>		<i>Caprifoliaceae</i>	common snowberry	Native	10
<i>Tellima</i>	<i>grandiflora</i>		<i>Saxifragaceae</i>	fringe cups	Native	5
<i>Torilis</i>	<i>sp.</i>		<i>Apiaceae</i>	hedge parsley	Introduced	1
<i>Toxicodendron</i>	<i>diversilobum</i>		<i>Anacardiaceae</i>	pacific poison oak	Native	2
<i>Trientalis</i>	<i>latifolia</i>		<i>Caryophyllaceae</i>	broadleaf starflower	Native	1
<i>Umbellularia</i>	<i>californica</i>		<i>Lauraceae</i>	California laurel	Native	10
<i>Urtica</i>	<i>dioica</i>	<i>holosericea</i>	<i>Urticaceae</i>	hoary nettle	Native	2
<i>Woodwardia</i>	<i>fimbriata</i>		<i>Blechnaceae</i>	giant chainfern	Native	1

The % cover is provided for each plant species found in each site.

Appendix F. Peninsula Reference Site Locations

Site	Community Type	Latitude	Longitude
S1	Serpentine bunchgrass	37.462878	-122.294872
S2	Serpentine bunchgrass	37.514516	-122.353826
S3	Serpentine bunchgrass	37.572201	-122.403932
V1a	Coastal terrace prairie	37.499451	-122.344004
V1b	Coastal terrace prairie	37.499251	-122.359286
W1	Freshwater marsh	37.572234	-122.403577
W2	Freshwater marsh (seasonal wetland)	37.462749	-122.307541
W3	Freshwater marsh	37.516605	-122.357151
O1	Coast live oak woodland	37.498983	-122.343167
O2	Mixed oak woodland	37.479251	-122.320067
R1	Coast live oak riparian forest	37.459822	-122.295466
R2	Coast live oak riparian forest	37.462636	-122.301926

Appendix F
Design Drawings
(To Be Submitted under Separate Cover)